ONTARIO SOIL, WATER AND AIR RESEARCH AND SERVICES COMMITTEE

2001 ANNUAL REPORT TO

ONTARIO AGRICULTURAL SERVICES COORDINATING COMMITTEE

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ONTARIO SOIL, WATER AND AIR RESEARCH AND SERVICES COMMITTEE

2001 ANNUAL REPORT

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EXECUTIVE SUMMARY

The 2001 OSWARSC Report is a summary of progress in the fourth year of our four year strategic plan, as well as a description of any new or revised research priorities. The report will be relatively brief, in keeping with the stage in the OASCC cycle. Summaries of the previous research recommendations are included, but the reader is referred to the 1999 report for the full text of these recommendations.

Research priorities for 2001 are again grouped according to the following Issues, listed in order:

1. **Manure Management**
2. **Nutrient Use Efficiency**
3. **Water Management**
4. **Identification / Validation of Best Management Practices**
5. **Soil and Crop Management**
6. **Biosolid / Waste Application and Treatment**
7. **Greenhouse Gas Emissions**

An eighth issue has been added to the list this year, reflecting the impact of the warm, dry weather of the past summer:

8. **Rural Air Quality**

There are no new research priorities identified with this issue, but several existing recommendations, concerning ground level ozone, smog, odours, ammonia, bio-aerosols, and particulates fit within this issue.

Water quality has remained a high profile issue, as the Walkerton Inquiry kept the impact of agriculture on water quality as headline news for much of the year. The other major issue was the impact of weather on both crops and environmental quality. Hot, dry conditions this summer led to a record number of smog alerts, sometimes extending as far north as North Bay, and significant stress on crops. There were also concerns with low stream flows in many watersheds. Adding insult to injury, the fall was very wet in many areas, leading to problems of soil compaction during a wet harvest season.

Four new research priorities were identified this year, as well as revisions of wording of some priorities. In particular, under Priority 1-2 on manure and biosolid application systems, it was suggested that "organic contaminants" be included as well as manure. The discussion of treatment and application effects on survivability of pathogens, particularly in regard to the predictability of these effects, needs to be added.

The new research priorities identified by the three sub-committees reporting to OSWARSC are:

- Priority 1-1: Quantify the biological, physical and socio-economic effects of manure management
- Priority 1-4: Scale of Farming vs. Losses to the Environment

- Priority 3-2: Development of improved water and nutrient management to improve water-use efficiency and water quality.
- Priority 7-2: To quantify the impact, benefits and detriments of climate change, and how to adapt to climate change and increased variability.

There was also a significant change in the order of priority within the Soil and Crop Management Issue, with Crop Rotation increasing to the top ranked research priority within this issue.

One emerging issue that was identified was the impact of aquaculture on water quality.

The next year will require a major effort to prepare for the strategic review of Soil, Water and Air research priorities.

OSWARSC State of the Industry Report

1. Major accomplishments in the past year

Several of the key researchers in the area of Soil and Water Management have been involved in providing expert testimony to the Walkerton Inquiry. It was certainly not anticipated that this was going to be the end result of past research recommendations. There is no doubt, however, that past research effort supported by the OASCC system provided much of the framework for their ability to give credible testimony. This underscores the continuing need for support of research in the public good.

Considerable expertise has also been directed towards the development of Bill 81 – the Nutrient Management Act, and to draft standards and regulations supporting the act. While the act has not yet been passed by the legislature, much of the groundwork has been laid.

One of the key recommendations from past reports was improvement of the infrastructure for managing soil, water and air data. In the 2000 report, we noted progress in developing a soils information database. This year, the agro-meteorology committee reports that there have been significant improvements in the Ontario Weather Network, which collects weather data in southwestern Ontario. This data is an important input into many pest management models, so there is a direct link between improved weather information and reduced pesticide use. There is much work still to be done, but it is a good beginning.

Research is on-going under many of the priorities identified in past reports, but to date have produced small incremental additions to our knowledge base rather than ground-breaking results. This does not, however, lessen the importance of this research.

Research activity is described in more detail in the Issue Champion reports, included elsewhere in this report.

2. State of the Industry

Water quality continued to be high in the public consciousness as the Walkerton Inquiry was in the news for much of the year. The response of the government in imposing stricter water regulations has caused concern in many smaller municipalities because of the cost of some required changes. There has been a sharp increase in the number of boil water orders, although it is unclear if this is from more incidences of contamination, or greater sensitivity on the part of municipal water authorities.

High energy prices through the winter of 2001 led to significant increases in the price of nitrogen fertilizer. This, coupled with stagnant corn prices, caused a much wider than normal spread between grain and fertilizer prices. Instead of the normal ratio of 5 kilograms of grain to buy one kilo of N, it took 8 kilos in 2001. Aside from the impact on the profitability of crop production, the wide price spread greatly increased the interest in nitrogen management.

The weather is probably the most significant story of this year. Hot, dry conditions throughout southern Ontario led to frequent and severe incidences of smog conditions. Smog warnings were issued for areas as far north as North Bay on several occasions. The dry weather also adversely affected crop production, reducing yields of both corn and, particularly, soybeans. Following a summer of moisture deficit, the fall was a period of moisture excess. Wet conditions at harvest of both soybeans and corn resulted in soil compaction and soil structural degradation in many fields. The impact of this year's harvest will be with us for a long time.

Last year's report pointed out the significant threat from conflicts between urban, rural non-farm, and agricultural land uses. Since then, the government has announced a development freeze on the Oak Ridges Moraine. This action should help to resolve some of the conflicts on a small, albeit sensitive, part of Ontario. Much work still remains to be done in this area.

Climate change and greenhouse gas emissions have received less public attention over the past year as other issues have taken precedence. Research is continuing on priority issues surrounding agriculture's impact on climate change and greenhouse emissions as we continue to move closer to ratifying the Kyoto agreement.

Legislation regarding the management of nutrients on agricultural land has been introduced in the legislature, and has begun the long process towards becoming law. OSWARSC applauds this move, but expresses hope that the regulations and standards, when they are finally introduced, are based on science rather than in response to extreme viewpoints.

The impending demise of the Environmental Farm Plan program continues to be of great concern to OSWARSC. This program has made great strides in raising the awareness about the role of agriculture in environmental management, but it has been existing on soft money from program to program. Despite the value of the program, it appears that it does not fit the criteria for any of the existing programs. It would be a shame if this program were allowed to disappear for lack of consistent funding.

3. Emerging Issues

In the 2000 report, it was suggested that it would be beneficial to combine research issues involving manure into a number of research thrusts. These suggestions for possible Research Thrusts bear repeating, as follows:

1. System Comparison of Liquid/Solid manure handling
2. Transport Pathways of Nutrients/Bacteria
3. Impact of manure treatments/handling on GHG emissions
4. Large vs. small operations

These thrusts cut across the mandates of the Plants, Natural Resources, Rural, and Economics programs, containing aspects of each of these programs. The combination

of priorities that are reflected in these suggested thrusts address many of the current concerns surrounding the impact of agriculture on water quality and quality of life.

One issue that has taken higher priority with the weather conditions of the past summer is rural air quality. Air quality has been a concern in urban environments for many years, but has not generally been considered in rural environments. The concentration of livestock operations, the increasing number of rural non-farm residents, and weather conditions that include large stagnant air masses, have all contributed to increasing the profile of rural air quality.

Another issue that may take on greater importance is the impact of aquaculture, particularly caged fish production, has on water quality. This issue is taking on importance as the aquaculture industry develops.

4. Summary of Soil, Water and Air Issues

This section attempts to provide an overview of the major issues identified by the three subcommittees. These are divided out into issues and research priorities later in the report, but a more comprehensive view may help to place these issues and priorities into context.

Soil:
The Ontario Soil Management Research and Services Committee (OSMRSC) is concerned with the impacts of soil management on both crop production and environmental quality. As such, it is concerned with the chemical, physical, biological, and to some extent, economic aspects of soil management.

Manure management is the dominant issue in soil management. The concentration of the livestock industry, and increased public awareness of off site impacts, have highlighted the need for understanding how to manage manure, and other organic materials, to maximize beneficial effects while minimizing adverse environmental impact, for a wide range of materials and cropping systems.

Also very important is the understanding of the inter-relationship between crop production systems and soil properties and sustainability. This includes crop rotations, tillage systems and nutrient applications. One gap that has been identified is the lack of work on soil management as it relates to horticultural crops. These have been largely ignored in the past because of the small acreage and wide diversity of crops, but they have the potential for significant environmental impact because of the intensity of the production systems.

Other key areas include identification of sources and pathways of environmental contaminants, and optimization of water management. These issues cross over between soil management, and both water and air management.

Water:
The Ontario Water Management Research and Services Committee is concerned with both the quantity and quality of water in Ontario, as it relates to agriculture and rural activities in Ontario. The issues and priorities surrounding this can be summarized in three points:

1. Identify the impacts of changing management practices on the leaching losses of pathogens, nutrients, feed additives (both quantities and timing during the year). To accomplish this, the pathways of contaminant movement need to be quantified, best management practices need to be tested and impacts quantified, and benchmark standards need to be developed for concentrations of contaminants in leaching waters and tile drains.
2. Fair and sustainable water sharing policies need to be developed, to ensure the continued availability of clean water for both agricultural and non-agricultural uses. This may include protection strategies for well heads and groundwater recharge zones, and innovative irrigation strategies for water conservation and to minimize leaching losses.
3. Both new and old designs for surface and groundwater protection (filter strips, wetlands, tile drain treatment systems, etc.) need to be tested for effectiveness as well as the relative cost and benefit of each system.

Air:
The Ontario Agrometeorology Research and Services Committee has focused most attention to the effect of weather on crop conditions, particularly with respect to weather based predictive models for pest or disease management. An increasing focus,. however, is the twin focii of climate change: measuring and adapting to climate change, and quantifying the net release of greenhouse gases from agricultural activities.

New Research Priorities

Priority 1-1: **Quantify the biological, physical and socio-economic effects of manure management, in part by developing an environmental index for N, and an appropriate environmental model that takes into account the influence of soil macropores on movement of materials through the soil.**

ISSUE: **MANURE MANAGEMENT; BIOSOLID/WASTE APPLICATION AND TREATMENT; RURAL AIR QUALITY**

SOURCE: Ontario Soil Management Research & Services Committee

OASCC LINKAGES: Animal Research and Services Committee
Field Crops Research and Services Committee
Engineering Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council

BACKGROUND: Environmental effects of manure may occur on the originating farm, or, more often, away from the farm in downstream watercourses and in the global atmosphere. Research is required to quantify the environmental costs of manure-handling activities to the farmer and to society. Likewise, there is a need to quantify the benefits to society, the costs to the farmer, and the net benefits (or costs) to the farmer and to society of the farmer adopting more environmentally benign manure-handling activities.

Priority 1-4: **Scale of Farming vs. Losses to the Environment**

ISSUE: **MANURE MANAGEMENT**

SOURCE: Ontario Soil, Water and Air Research & Services Committee

OASCC LINKAGES: Animal Research & Services Committee
Engineering Research and Services Committee
Rural Community Development Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs

Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Ontario Ministry of the Environment

BACKGROUND: There is a common assumption that large farms have a larger environmental "footprint" than smaller farms. While this notion is attractive, there is no data to support or refute it. Resolving this issue is critical to the development of meaningful and effective policies around manure management.

Priority 3-2: **Development of improved water and nutrient management to improve water-use efficiency and water quality.**

ISSUE: WATER MANAGEMENT: NUTRIENT USE EFFICIENCY

SOURCE: Ontario Soil Management Research & Services Committee

OASCC LINKAGES: Engineering Research & Services Committee
Field Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
Agricultural Research Institute of Ontario

BACKGROUND:
Dry weather during the summer of 2001 raised the profile of conflicts between agricultural, rural, and urban water use, both in terms of quantity and quality. Irrigation has long been recognised as an important part of a production system for high value crops, and may in future hold promise of improving yield, maturity and quality of other field crops. This will inevitably increase the impact of agriculture on the water resource. The inter-relationship between water use, nutrient use, and water quality must be fully investigated. In the greenhouse industry, an important environmental consideration is the safe disposal (re-use) of fertilizer effluent. The background issues are more fully discussed in the OSMRSC report.

Priority 7-2: **To quantify the impact, benefits and detriments of climate change, and how to adapt to climate change and increased variability.**

ISSUE: **GREENHOUSE GAS EMISSIONS; MANURE MANAGEMENT; RURAL AIR QUALITY; SOIL AND CROP MANAGEMENT**

SOURCE: Ontario Agro-meteorology Research And Services Committee

OASCC LINKAGES: Field Crops Research & Services Committee
Animal Research & Services Committee
Horticulture Research & Services Committee
Engineering Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council
Environment Canada

BACKGROUND:

The only certainty around climate change is that it will change the climatic conditions of much of Ontario. The impact of these changes needs to be predicted, and options for adaptation developed. Research to identify improved crop management systems, including cultivars adapted to a warmer, more variable climate, is required to maintain the sustainability and security of Canadian food supply.

RESEARCH ISSUES AND PRIORITIES

Background information concerning these research issues and priorities can be found in the 1999 OSWARSC Annual Report.

A. INFRASTRUCTURE ISSUES

OSWARSC identified a number of infrastructure issues in 1998 which cut across many of the 7 Priority Research Issues around which the 1998 OSWARSC priorities were organized and which must be properly addressed in order to implement the research priorities.

DATA COLLECTION, UPGRADE, MANAGEMENT AND DELIVERY

a) SOIL

Priority #I-A1: **To establish a provincial institute composed of MNR, OMAFRA, AAFC and Land Resource Science Dept., University of Guelph, to be responsible for the integrity of soil resource information for Ontario, and having a mandate to improve the quality of the soil resource information database through a program of soil research and data collection, management, analysis and transfer, to a level sufficient for the preparation of official plans, designation of significant/sensitive lands (e.g. prime agricultural lands; prime wetlands; degraded lands; lands posing risk to water quality), and other basic land use planning activities.**

ISSUE: **DATA COLLECTION AND MANAGEMENT**

SOURCE: **Ontario Soil, Water and Air Research & Services Committee**

OASCC LINKAGES:

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
Ontario Ministry of Natural Resources
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council

b) WATER

Priority #I-B1: **Develop an agricultural water management data bank.**

ISSUE: **DATA COLLECTION AND MANAGEMENT**

SOURCE: Ontario Water Management Research & Services Committee

OASCC LINKAGES: Engineering Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Ontario Ministry of the Environment
Ontario Ministry of Natural Resources
Canadian Agri-Food Research Council

c) AIR

Priority #I-C1: **Maintain and improve the quality and availability of weather data in Ontario.**

ISSUE: **DATA COLLECTION AND MANAGEMENT**

SOURCE: Ontario Agrometeorology Research & Services Committee

OASCC LINKAGES: Field Crops Research and Services Committee
Horticulture Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Environment Canada

ISSUE: **SCALING OF DATA**
EVALUATION OF BEST MANAGEMENT PRACTICES

***Priority II-1*:** **To develop methodology to evaluate the effect of scale (mapping and spatial) on the quantification and management of soil and water resources.**

SOURCE: Ontario Water Management Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council

RESEARCH ISSUES

These priorities are organized according to the primary issue that is addressed, and given a rough ranking within that priority. No attempt has been made to rank the

research issues, and none should be implied by the order in which they are listed. Note that many of the research priorities cross over two or more issues.

Priority 1-1: **Quantify the biological, physical and socio-economic effects of manure management, in part by developing an environmental index for N, and an appropriate environmental model that takes into account the influence of soil macropores on movement of materials through the soil.**

ISSUE: **MANURE MANAGEMENT; BIOSOLID/WASTE APPLICATION AND TREATMENT**

SOURCE: Ontario Soil Management Research & Services Committee

OASCC LINKAGES: Animal Research and Services Committee
Field Crops Research and Services Committee
Engineering Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council

BACKGROUND: Environmental effects of manure may occur on the originating farm, or, more often, away from the farm in downstream watercourses and in the global atmosphere. Research is required to quantify the environmental costs of manure-handling activities to the farmer and to society. Likewise, there is a need to quantify the benefits to society, the costs to the farmer, and the net benefits (or costs) to the farmer and to society of the farmer adopting more environmentally benign manure-handling activities.

Priority 1-2: **Development of better manure and biosolid application systems to improve nutrient efficiency and reduce the impacts on environmental quality**

ISSUE: **MANURE MANAGEMENT; NUTRIENT USE EFFICIENCY; BIOSOLID/WASTE APPLICATION AND TREATMENT; RURAL AIR QUALITY**

SOURCE: Ontario Soil Management Research & Services Committee

OASCC LINKAGES: Animal Research and Services Committee
Field Crops Research and Services Committee

Engineering Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council

An additional aspect of this priority that needs to be added is research into the preferential flow of manure and other organic contaminants through soil macro-pores. Movement of liquid manure into tiles through macro-pores has been documented, and this can result in the direct transmission of nutrients and bacteria into surface water. There is little information about the impact of application rate on preferential flow, or on management techniques to minimize or eliminate preferential flow to tiles.

Priority 1-3: **Determine the best methods to evaluate the effectiveness of manure treatment technologies, and to develop protocols for evaluating treatment technologies including on-site testing for odours.**

ISSUE: **MANURE MANAGEMENT; EVALUATION OF BEST MANAGEMENT PRACTICES; RURAL AIR QUALITY**

SOURCE: Ontario Soil Management Research & Services Committee

OASCC LINKAGES: Animal Research & Services Committee (ARSC)

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council

Priority 1-4: **Scale of Farming vs. Losses to the Environment**

ISSUE: **MANURE MANAGEMENT**

SOURCE: Ontario Soil, Water and Air Research & Services Committee

OASCC LINKAGES: Animal Research & Services Committee
Engineering Research and Services Committee
Rural Community Development Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region

University of Guelph
Agricultural Research Institute of Ontario
Ontario Ministry of the Environment

BACKGROUND: There is a common assumption that large farms have a larger environmental "footprint" than smaller farms. While this notion is attractive, there is no data to support or refute it. Resolving this issue is critical to the development of meaningful and effective policies around manure management.

Priority 1-5: **Identification of Sources of Surface Water Contaminants**

ISSUE: **MANURE MANAGEMENT; WATER MANAGEMENT; BIOSOLID/WASTE APPLICATION AND TREATMENT**

SOURCE: Ontario Soil Management Research & Services Committee

OASCC LINKAGES: Animal Research & Services Committee
Engineering Research and Services Committee
Rural Community Development Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Ontario Ministry of the Environment
Ontario Ministry of Health

Priority 2-1: **Improving NPK fertility management of corn, cereal crops, canola, horticultural crops and tobacco for increased yield, quality and profitability, and reduced environmental impact.**

ISSUE: **NUTRIENT USE EFFICIENCY**

SOURCE: **Ontario Soil Management Research & Services Committee**

OASCC LINKAGES: Field Crops Research & Services Committee
Horticultural Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario

This research priority needs to be tied into the development of Nutrient Management Plans (NMP's), particularly as they move from being a recommended to a mandated practice. Many of the horticultural crops, for example, lack any data on the nutrients taken up by the crop or removed with the harvested portion, yet this data is necessary if nutrient application is going to be limited in some circumstances to crop removal. The measurement of impact on soil levels of nutrients should become a matter of course for any fertilizer trials.

Priority 3-1: **Defining transport pathways to ground and surface waters for Pesticides, Nutrients and Bacteria.**

ISSUE: **WATER MANAGEMENT**

SOURCE: Ontario Water Management Research & Services Committee

OASCC LINKAGES: Animal Research & Services Committee
Field Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
Agricultural Research Institute of Ontario

Background:

It is well known that contaminants can show up in shallow aquifers, but the exact pathways that these contaminants follow are not known. To quantify the movement of contaminants with various properties into groundwater or tile lines, it is critical to understand what pathways they follow. With this understanding, it will be possible to design effective management systems to minimize the movement of contaminants through the soil profile.

Priority 3-2: **Development of improved water and nutrient management to improve water-use efficiency and water quality.**

ISSUE: **WATER MANAGEMENT: NUTRIENT USE EFFICIENCY**

SOURCE: Ontario Soil Management Research & Services Committee

OASCC LINKAGES: Engineering Research & Services Committee
Field Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
Agricultural Research Institute of Ontario

BACKGROUND:

Dry weather during the summer of 2001 raised the profile of conflicts between agricultural, rural, and urban water use, both in terms of quantity and quality. Irrigation

has long been recognised as an important part of a production system for high value crops, and may in future hold promise of improving yield, maturity and quality of other field crops. This will inevitably increase the impact of agriculture on the water resource. The inter-relationship between water use, nutrient use, and water quality must be fully investigated. In the greenhouse industry, an important environmental consideration is the safe disposal (re-use) of fertilizer effluent. The background issues are more fully discussed in the OSMRSC report.

Priority 3-3: **To quantify a Farm Water Cycle.**

ISSUE: **WATER MANAGEMENT**

SOURCE: Ontario Water Management Research and Services Committee

OASCC LINKAGES: Engineering Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region;
Agricultural Research Institute of Ontario

Background:
An understanding of the movement of water through the various farming systems is critical in developing policies for water management. The water budget can be separated into three components:

1. partitioning/budgeting
   This includes the partitioning of precipitation between runoff and infiltration, and the division of the infiltration between evaporation, crop uptake and transpiration, drainage through tiles, and deep drainage.
2. irrigation management
   Research is needed into the accurate prediction of irrigation requirements, as well as the partitioning of the applied water, the same as for precipitation.
3. competition/sharing
   As demands for both surface and groundwater increase for urban, rural non-farm and agricultural uses, an understanding of the competition between these various uses and the impacts on water quantity and quality are critical.

Priority 3-4: **Determining the Optimal Type, Width and Management of Riparian Buffer Strips to Reduce Sediment, Nutrient and Pesticide Loss into Watercourses**

ISSUE: **WATER MANAGEMENT**

SOURCE: Ontario Soil Management Research & Services Committee

OASCC LINKAGES: Animal Research & Services Committee

Field Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
Agricultural Research Institute of Ontario
Ontario Ministry of Natural Resources

Priority 3-5: **To quantify water quality functions for Ontario wetlands.**

ISSUE: **WATER MANAGEMENT**

SOURCE: Ontario Water Management Research and Services Committee

OASCC LINKAGES: Engineering Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region;
Agricultural Research Institute of Ontario
Ontario Ministry of the Environment
Ontario Ministry of Natural Resources

Priority 4-1: **Developing crop rotation systems to enhance soil quality and improve crop productivity**

1) Maximizing Yields Under a Short Term Soybean Rotation
2) Crop Rotation and Sequence Effects on Soil
3) Cover Crops in Horticultural Systems

ISSUE: **SOIL AND CROP MANAGEMENT**

SOURCE: Ontario Soil Management Research & Services Committee

OASCC LINKAGES: Field Crops Research & Services Committee
Horticulture Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario

Priority 4-2: **Improving the management, productivity and profitability of field crop production by increasing our understanding of temporal and spatial variability of soil properties in agricultural fields.**

ISSUE: **SOIL AND CROP MANAGEMENT**
NUTRIENT USE EFFICIENCY

SOURCE: Ontario Soil Management Research & Services Committee

OASCC LINKAGES: Field Crops Research & Services Committee
Horticultural Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario

Priority 4-3: **Overcoming factors limiting crop production when growing no-till corn and horticultural crops**

1) Fine Tuning No-till Systems
2) Managing Wheat Residue
3) Lime application:
4) Reduced Tillage Systems for Vegetable Production

ISSUE: **SOIL AND CROP MANAGEMENT**

SOURCE: Ontario Soil Management Research & Services Committee

OASCC LINKAGES: Field Crops Research & Services Committee
Horticultural Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario

Priority 4-4: **Modeling for Integrated Pest Management (pest development, optimum treatment timing), Crop Growth, Irrigation Management**

ISSUE: **SOIL AND CROP MANAGEMENT**

SOURCE: Ontario Agro-meteorology Research & Services Committee

OASCC LINKAGES: Field Crops Research & Services Committee
Horticultural Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario

Background:

Development of models, based on real time weather data, for IPM, crop growth, and irrigation management will go a long way towards increasing the efficiency of crop production and reduce the unnecessary use of pesticides. This will both increase net farm income and reduce the potential impact on the environment.

Priority 5-1: **To quantify the effectiveness of various Best Management Practices that are being recommended and implemented by the farm sector to reduce and/or control contamination of surface and ground water resources by agricultural fertilizers (organic and inorganic), pesticides, and sediments.**

ISSUE: **EVALUATION OF BEST MANAGEMENT PRACTICES; NUTRIENT USE EFFICIENCY; WATER MANAGEMENT**

SOURCE: Ontario Water Management Research and Services Committee

OASCC LINKAGES: Field Crops Research & Services Committee
Horticultural Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region;
Agricultural Research Institute of Ontario

Priority 5-2: **Development of techniques, practices and amendments that improve water management on fine-textured soils.**

ISSUE: **EVALUATION OF BEST MANAGEMENT PRACTICES; WATER MANAGEMENT**

SOURCE: Ontario Water Management Research and Services Committee

OASCC LINKAGES: Field Crops Research & Services Committee
Horticultural Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affair

Agriculture and Agri-Food Canada, Eastern Region
Agricultural Research Institute of Ontario

***Priority 6-1*: To conduct research to quantify short and long-term effects (positive and negative) of land application of biosolids, towards the development of application protocols based on their properties**

ISSUE: **BIOSOLID / WASTE APPLICATION AND TREATMENT**

SOURCE: Biosolids Issue Champion

OASCC LINKAGES: Field Crops Research & Services Committee
Horticulture Research & Services Committee
Engineering Research & Services Committee
Rural Community Development Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Ontario Ministry of the Environment
Ontario Ministry of Health
Agriculture and Agri-Food Canada, Eastern Region
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council

***Priority 6-2:* To develop practical remedial techniques for managing environmental impacts of existing contamination, and evaluating their economic feasibility.**

ISSUE: **BIOSOLID / WASTE APPLICATION AND TREATMENT**
WATER MANAGEMENT; MANURE MANAGEMENT

SOURCE: Ontario Water Management Research and Services Committee

OASCC LINKAGES: Animal Research and Services Committee
Engineering Research and Services Committee
Economics Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
Agricultural Research Institute of Ontario
Ontario Ministry of the Environment

***Priority 7-1*: To continue to support the measurement and modelling of greenhouse (trace) gases, and to continue the association of this work with research on management systems for nitrogen and organic wastes.**

ISSUE: **GREENHOUSE GAS EMISSIONS; MANURE MANAGEMENT; RURAL AIR QUALITY; SOIL AND CROP MANAGEMENT**

SOURCE: Ontario Agrometeorology Research And Services Committee

OASCC LINKAGES:
Field Crops Research & Services Committee
Animal Research & Services Committee
Horticulture Research & Services Committee
Engineering Research & Services Committee

TARGET AGENCY:
Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council
Environment Canada

***Priority 7-2*: To quantify the impact, benefits and detriments of climate change, and how to adapt to climate change and increased variability.**

ISSUE: **GREENHOUSE GAS EMISSIONS; MANURE MANAGEMENT; RURAL AIR QUALITY; SOIL AND CROP MANAGEMENT**

SOURCE: Ontario Agro-meteorology Research And Services Committee

OASCC LINKAGES:
Field Crops Research & Services Committee
Animal Research & Services Committee
Horticulture Research & Services Committee
Engineering Research & Services Committee

TARGET AGENCY:
Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council
Environment Canada

BACKGROUND:

The only certainty around climate change is that it will change the climatic conditions of much of Ontario. The impact of these changes needs to be predicted, and options for adaptation developed. Research to identify improved crop management systems, including cultivars adapted to a warmer, more variable climate, is required to maintain the sustainability and security of Canadian food supply.

Appendix I - Sub-Committee Reports

Agrometeorology Research and Services Committee
Minutes of the meeting November 14 2001
Room 038 Richard's Building, University of Guelph

Present

Chair: Alan McKeown, U. of Guelph
Peter Brunner, Ontario Soils and Crop Association
Ian Nicholls, Ridgetown College
Heather Griffiths, OMAFRA,
Henry Hayhoe, Agriculture and Agrifood Canada
Terry Gillespie, U of Guelph,

Regrets:
Tom Jewett, Agriculture and Agrifood Canada
Ron Pitblado, Ridgetown College
Jon Warland , U of Guelph
Chis Marshall, Environment Canada
Randy Mawson, Environment Canada

Reports

Written reports were presented by Terry Gillespie, Henry Hayhoe, Jon Warland and are attached.

A long discussion was held on implications of the hot, dry conditions experienced in 2001 and other recent years. Adaptation to climate warming or increased climate variability will take considerable effort in research and by growers to maintain food supplies. It was concluded that management practices need to be developed and cultivars adapted to more heat, more variable climate need to be developed to maintain food supply. Irrigation scheduling and water related issues will be also be increasingly important. If the weather of 2001 becomes more frequent then irrigation may spread to other crops than horticultural crops or tobacco currently irrigated. This will increase demand on resources.

There were more smog days than normal in 2001, and they occurred earlier than usual in the season. Air pollution injury was observed on all susceptible crop species this year. Smog probably added to lower yields from other weather conditions. The effects of air pollution on crops need to be monitored.

As a result of these discussions, it was decided that there was a need for a workshop on adaptation to climate change. It was also suggested that such a workshop with growers would be advantageous. Peter Brunner will ask the Soils and Crops executive

if they will have a workshop on adaptation to climate change. Terry Gillespie and Alan McKeown will coordinate resource people for this event if it takes place.

Ian Nicholls reported on activities of the Ontario Weather Network in 2001. The client list is improving and is positive news. A number of weather related fee for service activities were performed in 2001. Tomcast disease prediction services were offered again in 2001. The network has access to various weather station across the province. The issue of access to and maintenance of weather stations remains an issue. Availability of agricultural forecasts is an issue as Environment Canada has ceased that aspect of forecasting.

Jon Warland sent comments expressing concern about water budgets and climate change. A better understanding irrigation and the partitioning of water in agricultural soils and the impacts on production and food supply.

Committee membership was discussed and several new potential members will be contacted to serve on this committee.

Research and Services Priorities

The committee strongly supported all ongoing research and last years priorities.

Last years priorities, needs and emerging issues were discussed at length. A number of issues were identified:

Services
-quality of the weather radio network, holes in data and coverage, severe weather broadcasts.
-micro climate issues, especially for Hort crops wrt predictive models, data, reports, distribution to end users.
-look across borders for working models.
-diagnostics for environmental damage.
- monitoring of smog effects on crops.

Research
-develop models for other crops for example:
- IPM,
- Irrigation,
- insects, eg corn borer in peppers,
-not having IPM programs may be barriers to new Pesticide Registration
-identify, acquire, validate models from other locations. Adapt those suitable and develop models to fill gaps.

Emerging issues carried forward from 2000.

-adapting agricultural production systems to climate change and detecting effects of climate change on crop yields.

-carbon sequestering by no-till
-air pollution, with the early and number of smog days this year, air pollution injury was noticed virtually everywhere in Ontario. Most crops are known to be sensitive and crop damage needs to be accounted for.

Irrigation scheduling, access to water, water use, competition for water, nutrient management will be increasingly important even without Global Warming. Evapotranspiration is the basis of irrigation scheduling models. However, the two models that are used do not agree in Ontario. One works well in the Guelph area, the other works well in Harrow. Outside of these areas results do not agree. Thus in addition to work on scheduling, water use efficacy, work is needed on evapotranspiration models that work across the Province.

2001-1R. Continue to support work to measure and model of greenhouse gasses, expand research on diffusion/dispersion of various gasses (eg. odours) in agricultural situations. Continue with research on management systems for nitrogen and organic wastes. There is a lot of uncertainty in climate change prediction and current spatial resolution is not adequate for agriculture uses. We need to update climate impact analyses on agriculture as new climate predictions become available.

2001-2R. Continue to support the development and testing of weather based predictive models for: use in applications such as pest/disease management, nutrient management, crop growth models and irrigation scheduling. Models need to include wide area to site specific predictions depending on the needs of the crop and grower. A better understanding of water budgets, supply and estimating potential evaporation for use in irrigation scheduling models is required.

2001-3R. Quantify the impact, benefits and detriments of climate change and how to adapt to climate change and increased variability. Develop improved crop management systems, including cultivars adapted to warmer, more variable climate. This work is required to maintain sustainability and security of food supply for Canadians.

2001-4R. Smog damage is becoming an issue with increased number of smog days and injury.
The damaged needs to be monitored and accounted for in crop yields.

2001-1S/R Continue to attack the problem of deteriorating quality and availability of weather data in Ontario.

There has been considerable improvement with activities of the Ontario Weather Network.

More co-operating stations and commercial clients have signed up in 2001. The issue about autostation maintenance, repair and replacement is still a major issue.

Weather data is a core component of programs to help reduce agricultural impact on the environment ans maintain productivity. These include pesticide management and reduction, irrigation scheduling for efficient water usage, minimize leaching surface runoff and soil degradation.

Priorities directed to
OMAFRA, Agriculture and Agrifood Canada, University of Guelph, and Environment Canada Meteorological Service of Canada and Environmental Protection Divisions.

Appendix 1. reports

SUMMARY OF AGROMETEOROLOGICAL ACTIVITIES AT THE GUELPH CAMPUS, UNIVERSITY OF GUELPH.

Prepared for the meeting of the Ontario Agrometeorology Research and Services Committee
November 14, 2001.

Summary of Research Activities in the Agrometeorology Group Land Resource Science, University of Guelph

Prepared for the Ontario Agrometeorology Research and Services Committee Meeting
Nov. 14, 2001.

Development and Evaluation of Methods to Monitor the Impact of Landfarms on the Atmosphere
Sandra Ausma, Terry Gillespie, Grant Edwards

Trace gas emissions were investigated from soils where hydrocarbon wastes had been applied. Field and lab-scale methods were developed and used to quantify emissions and evaluate their impact. A flux gradient and aerodynamic mass balance micrometeorological method were used to measure total hydrocarbon (THC) and CO_2 fluxes during measurements at two active refinery landfarms in Ontario. The methods worked well and allowed the unobtrusive real-time measurement of fluxes during the spreading of oily liquid wastes and dewatered biosolids, and during cultivating of the landfarm surface.

Static chamber methods were also developed and used to measure trace gas fluxes (THC, CO_2, and N_2O) from a remotely located diesel-fuel contaminated soil landfarm. A modified static chamber method measured THC fluxes in real-time. Data was collected in 10 minutes or less, minimizing the influence of the chamber's presence on the measured fluxes. Experiments were successfully performed to characterize landfarm emissions and to evaluate the impact of cultivation on emissions.

A laboratory-scale simulator facility was designed and constructed to measure trace

gas fluxes from contaminated soils in real-time. Five simulators were integrated with a data acquisition system and trace gas analyzers; allowing automated sampling and calculation of THC, CO_2 and water vapour fluxes. N_2O fluxes were calculated using a discrete sampling method. Experiments were performed to evaluate the impact of simulated cultivation and rainfall on trace gas fluxes. Fluxes measured using the simulators were similar in magnitude to field results and effects observed during field studies were reproduced.

Results from the studies were used to assess the impact of landfarm emissions and to recommend strategies for mitigation of emissions. A Gaussian areal source dispersion model was used to estimate airborne concentrations of hydrocarbons. Maximum concentrations were found to occur on the downwind edge of the landfarms. Maximum concentrations were at least an order of magnitude smaller than published exposure limit values for specific hydrocarbons, suggesting a minimal inhalation risk to humans. Recommendations were provided to landfarm operators to aid in minimization of volatile emissions while maintaining soil conditions for waste reduction.

An investigation of two methods for source identification of Ambient isoprene in the lower Fraser Valley, British Columbia
Christine J. Rigby and Terry J. Gillespie

This work was an investigation of two methods for identifying sources of ambient isoprene in the Lower Fraser Valley of British Columbia. Isoprene is a reactive volatile hydrocarbon which is definitely known to be emitted by certain kinds of vegetation (most notably selected deciduous trees) and is also suspected to be a by-product of fossil fuel consumption. Its high reactivity makes it a strong participant in the production of low-level ozone smog in environments with high concentrations of oxides of nitrogen (NOx). Vancouver, with its west coast location, is an ideal place to study the formation and potential reduction of smog because the pollution is generated locally rather than advected from great distances. If anthropogenic isoprene production is significant compared to biogenic production, then curtailment of anthropogenic sources might be a viable ozone abatement strategy. Therefore, identifying whether isoprene results from biogenic or anthropogenic sources is a desirable goal.

The first portion of this study investigated the potential use of the $^{13}C/^{12}C$ ratio to separate biogenic from anthropogenic sources of ambient isoprene. Results showed a dependence of $\delta^{13}C$ in isoprene emitted by Velvet Bean on temperature, light and leaf age, with typical values of –28.06 ± 1.94 per mil. The values obtained could be explained by a combination of discrimination against $^{13}CO_2$ by photosynthesis and the subsequent production of isoprene from recent photosynthate. Unfortunately, the fractionation values for biogenic isoprene overlap with those from anthropogenic sources, ruling out the use of this technique as a direct source tracer for ambient isoprene.

The second portion of this study investigated the use of more traditional source apportionment techniques for identifying sources of ambient isoprene in and around Vancouver, B.C. These techniques included co-occurrence of isoprene with other

volatile hydrocarbons known to result from fuel consumption, and comparison of isoprene time trends with expected biogenic emission patterns calculated from observed temperatures and solar radiation. In winter, when the mixed layer in the lower atmosphere is shallow, observed isoprene concentrations were often relatively high. Considering the cool temperatures at this time of year and the lack of leaves on deciduous trees, this isoprene must have been from anthropogenic sources. In summer, transects from west to east across the city suggested that isoprene was mainly from biogenic sources near the western end of the city (deciduous forest upwind), mainly anthropogenic downtown, of mixed sources in a suburban area east of the city core, and mainly biogenic once again in the rural area east of the city.

Establishment of Long-term Evapotranspiration Measurement at Elora Research Station

J. Warland and K. Taillon

In July 2000 we deployed two eddy correlation systems at an extensively instrumented field site at the Elora Research Station. These systems use high-frequency measurements of the three wind components, air temperature, and CO2 and H2O concentration to calculate evapotranspiration and sensible heat flux from the surface.

The two systems have been in almost continuous operation since July in several arrangements. When first deployed, they were placed close together at the same height.

For much of the winter they were then run vertically aligned at 1 and 2 m. Currently they are being run both at 1.5 m but on opposite sides of the tower. Preliminary analysis of the data indicates that the systems are in good agreement and that our operational protocol is reliable. Now that we have confidence in the systems, one will be dedicated to long-term measurements of evapotranspiration as part of a larger study examining the water and nitrogen budgets.

Field Evaluation of Management Practices for Reduction of Nitrous Oxide Emission

N. McLaughlin, and C. Wagner-Riddle.

Nitrous Oxide (N_2O) is a very potent greenhouse gas. In Canada, the agricultural sector is the most important contributor of nitrous oxide emissions as an anthropogenic source of the gas. More research is needed to identify agricultural practices that influence N_2O emissions. This three year corn, soybean, wheat rotation study investigates the effect of two contrasting management systems on N_2O fluxes. One system, termed the conventional system, included tillage and N fertilizer applied at the recommended rate at planting. The second system, also known as the best management system, employed a no-till strategy and soil samples to determine N

fertilization rates. N_2O emissions were measured using micrometeorological methods and a tunable diode laser trace gas analyzer. The study was conducted at the Elora Research station (20 km north of Guelph, ON) from January 2000 to August 2000. The study included four plots of 1.5 ha in size in which a corn crop was established in 1999. In April 2000, the plots were seeded in corn. To determine the N_2O fluxes, the air was sampled at 20 second intervals from two heights above the crop and these data were averaged each hour. After the crop was fertilized, the N_2O emissions were approximately three times greater in both of the conventional plots when compared to the two best management plots. Preliminary data analysis suggest that there are significant differences between the two management systems.

Tracing the fate of fertilizer N applied to corn under two contrasting soil management systems in southern Ontario.

S. *Jayasundara, and C. Wagner-Riddle*

Agricultural management practices have affected emission of N_2O, and may contribute about 70 to 90% of the anthropogenic emissions of N_2O. Increased N_2O emissions from soils are associated with increased inputs of inorganic N and animal manure, biological N_2 fixation and enhanced N mineralization. Studying the fate of N applied to soil-plant system is, therefore, important from an environmental standpoint. In this study, we used 15N tracer to study the fate of N applied to corn in two soil management systems, as part of a long-term field experiment aimed at understanding inter-annual variability in N_2O fluxes. The experiment was located on a Woolwich Silt Loam soil (Typic Hapludalf) at Elora Research Station, University of Guelph. Two management systems were: (a) conventional tillage (CT) by fall moldboard ploughing with 150 kg N ha^{-1} applied as urea before planting; (b) Zero tillage (NT) with 50 kg N ha^{-1} (based on PSD N test) applied as 28% urea/Ammonium nitrate solution at 6 leaf stage. Corn in both management systems obtained around 70% of its N from the soil while fertilizer N contributing only 30% of corn N. The fertilizer recovery, when expressed as a % of applied N, was 24% (36 kg ha-1) in the conventional systems and 62% (32 kg ha^{-1}) in the No-tillage system. However, 53% of N applied (80 kg N ha^{-1}) was still in the soil in the CT at the end of the season, while only 26% (13 kg N ha^{-1}) was in the soil in NT. The 15N lost were doubled in CT (23%) as compared with NT (11%). Soil profile 15N distribution showed that nearly 40% of the ^{15}N remaining in the soil in CT was in the top 30 cm of the profile, while the rest had leached down to deeper in the profile. The ^{15}N distribution in the profile was more or less uniform in the NT system. Applying less N (50 vs. 150 Kg N/ha) at an earlier stage (6-leaf vs. at planting) resulted in a higher percentage of the fertilizer N in plants in a no-tillage system, when compared to a conventional system. Total losses of nitrogen in the form of nitrous oxide (a greenhouse gas) from January to July was lower in a no-tillage system when compared to a conventional treatment, although at times the no-tillage presented higher losses.

Quantifying emission of nitrous oxide and methane from anaerobic storage of liquid swine manure in Southern Ontario.
A.G. Thompson and C. Wagner-Riddle.

Agriculture has been identified as the primary anthropogenic source of both nitrous oxide (N_2O) and methane (CH4) emissions. These gases are emitted from a wide variety of agricultural practices, including the collection and storage of animal wastes. To better understand the contribution of manure storage on N_2O and CH4 emissions research, primarily conducted in Europe and the United States, has worked towards quantifying the release of the above gases from different storage systems. Unfortunately, this research may not accurately represent Canadian conditions due to differences in agricultural production practices and climate. To better understand the emission rates related to Canadian conditions, the fluxes of N_2O and CH4 from manure collected and anaerobically stored at a farrow to finish swine operation (Arkell Research Farm, Arkell, ON) were monitored. Emissions were determined using the integrated horizontal flux method during four periods of the year; June 27 - July 18 2000, Oct. 20 - Nov. 5 2000, Dec. 6 - 13 2000, Mar. 18 - Apr. 7 2001. To enable measurements to be taken from a range of wind directions four sampling towers were erected around the storage tanks, with air sample intakes placed at four heights on each tower. Two additional towers were erected equipped with one wind vane and four cup anemometers, the latter placed at equivalent heights to the sample intakes. Gas concentrations were measured using two Tunable Diode Laser Trace Gas Analysers, TDLTGA, one for N_2O and one for CH4. Results of these measurements are currently being analyzed.

Methane and nitrous oxide emissions from a liquid swine manure composting system.
A.G. Thompson, C. Wagner-Riddle, R. Fleming, and M. MacAlpine.

Increasing environmental concerns associated with liquid swine manure storage facilities has lead many producers to seek alternative storage techniques. Composting the liquid manure with a high carbon substrate before storage has received increased attention, primarily due its ability to minimize odour, reduce the volume of overall wastes, and reduces environmental risks associated with application to surrounding agricultural lands. Unfortunately minimal knowledge is available on the production of nitrous oxide and methane, both powerful greenhouse gases, during the composting process. The objective of this research is to quantify the production of these gases during a typical composting cycle and compared these emissions with those from a typical liquid manure storage system in order to determine which process minimizes production of these gases. The composting process was examined at Ridgetown College, Ridgetown ON, using a farm-scale in vessel forced aeration composter. The building housing the composting system was converted into an open chamber, with continuous air flow provided by two barn fans located at each end of the building. The concentration of the gases in the air both entering and leaving the chamber was measured, using two Tunable Diode Trace Gas Analysers, TDTGA, one for nitrous

oxide and one for methane. Using the concentration difference and rate of air flow an emission flux was calculated, and an estimate of overall emissions was derived. Results are currently being analyzed and will be compared to emissions of nitrous oxide and methane from a typical Southern Ontario liquid swine manure storage system, to evaluate if composting results in a reduction of greenhouse gas emissions.

Highlights of Agrometeorological Activities
Eastern Cereal and Oilseed Research Centre
Agriculture and Agri-Food Canada
November 14, 2001

1. Agrometeorological activities are concentrated in a study entitled: Agroclimatic Resource Assessment in a Changing Climate. The objective of the study is to develop methodologies and to carry out agroclimatic resource assessments for current and forecast climate scenarios to identify impacts, opportunities and adaptation strategies. The study leader is Henry N. Hayhoe and the collaborators are Andy Bootsma, Reinder DeJong and David Lapen. Activities within the study include:

a) Development of agro-climatic databases and information for use in modelling and agro-climatic assessments which involves: i) updating daily climate archive for over 650 climate stations in Canada with year 2000 data ii) developing gridded historical daily climate data for selected agricultural regions in Canada as baseline data for future impact assessments of climate change.

b) Analysis of the relationships between incidence of vomitoxin (deoxynivalenol or DON) in grain corn in Ontario and seasonal weather conditions. Attempts are being made to test previously developed relationships between vomitoxin levels and precipitation and temperature variables on an independent set of vomitoxin data.

c) Evaluation of climatic and soil factor contributing to winter survival of winter wheat using seven years of records of winter survival of winter wheat on a low lying plot on the Central Experimental Farm in Ottawa.

d) Designing and implementing automated procedures to make the new climate reference station at the Ottawa weather site available in near-real time on the Intranet.

e) Preparing a report on the communication of agrometeorological information in North and Central American countries for World Meteorological Organization, Commission for Agricultural Meteorology.

f) Contributing to the development of metadata standards for agrometeorological data by participating in a World Meteorological Organization expert team on Integrated Data Management.

g) Using weather data generators and agroclimatic indices for climate change impact assessment. This involves evaluating the probability distribution of corn heat units, precipitation deficits, and frost free periods for historical data and climate change scenarios based on doubling CO_2 for Ottawa.

h) Reinder DeJong is currently on a work transfer to Enschede (Netherlands) to study methodologies for integrating remote sensing data into crop models.

2. Three studies which were supported by the Climate Change Action Fund have been completed. They include:

a) An evaluation potential impact of climate change on the risk of winter injury to overwintering crops in Eastern Canada (collaborative project with Ste-Foy RC). Results of the research on potential impacts on winter survival of perennial forage crops and on fruit trees in eastern Canada (including Ontario) are being summarized and drafted into two scientific papers.

b) An evaluation of potential impacts of climate change on suitability/capability of Atlantic region to produce corn, soybeans and cereal crops by assessment of appropriate heat and moisture indices. The final report is available on the Internet as an Adobe pdf document at: http://res2.agr.ca/ecorc/staff/bootsma/boot-a1.htm

c) An evaluation of crop yields under historic and climate change scenarios using the EPIC model at 29 selected locations across Canada, including six in Ontario. The EPIC model was used to simulate changes in yields for a range of crops by running the model on baseline historical daily data (1965-1995), and for the 2040-2060 period, or approximately a doubling of CO_2. Crops included were barley, spring wheat, winter wheat, canola, corn, soybeans and potatoes (not all crops were simulated for all areas). The simulations were done using a representative soil for each locality, and typical soil and crop management practices.

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Currently, a large portion of ag-met research effort is directed towards the measurement of greenhouse gas emissions from various agricultural systems. Though this is clearly important research, I believe that it is being disproportionately emphasized versus other important agro-meteorological topics. A particularly

self-defeating example of this is the lack of organized studies of micrometeorological flux measurement techniques. There is much loud debate within the community as to whether or not eddy covariance techniques systematically underestimate fluxes, but it is still the most common technique for making greenhouse gas flux measurements (and the technique from which corrections for other methods are derived). Until the question of its reliability is satisfactorily answered, most of our estimates of GHG budgets are suspect.

A second topic which requires much more attention in Ontario is the water budget. Several recent events, such as Walkerton and theis year's drought conditions, underline the importance of water, and we know that we face a risk of decreased precipitation over the coming decades. Of particular importance to agriculture is understanding just how precipitation or irrigation are partitioned between drainage, evaporation and transpiration, and how we can best manage our cropping systems for the greatest water efficiency without degrading the soil. In particular, I believe that we should be examining irrigation much more closely as a tool for sustaining agriculture in a changing climate and for increasing farmland productivity with minimal environmental impact.

Comments from Jon Warland re agrometeorology research

Currently, a large portion of ag-met research effort is directed towards the measurement of greenhouse gas emissions from various agricultural systems. Though this is clearly important research, I believe that it is being disproportionately emphasized versus other important agro-meteorological topics. A particularly self-defeating example of this is the lack of organized studies of micrometeorological flux measurement techniques. There is much loud debate within the community as to whether or not eddy covariance techniques systematically underestimate fluxes, but it is still the most common technique for making greenhouse gas flux measurements (and the technique from which corrections for other methods are derived). Until the question of its reliability is satisfactorily answered, most of our estimates of GHG budgets are suspect.

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ONTARIO SOIL MANAGEMENT RESEARCH AND SERVICES COMMITTEE 2001 REPORT TO ONTARIO SOIL, WATER AND AIR RESEARCH AND SERVICES COMMITTEE

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Complete Prioritised Listing of 2001Research Recommendations
Research Studies Addressing the 2001 Research Recommendations
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Executive Summary

The annual meeting of the Ontario Soil Management Research and Services Committee (OSMRSC) was held at SCPFRC, AAFC, London on June 12, 2001. Members presented various subcommittee reports outlining updates on research progress, research priorities and suggested changes to OMAFRA Publications pertaining to field crop production, horticultural crop production, tobacco production, waste utilization, soil and water quality and soil testing. The horticultural crops subcommittee expressed concern regarding the lack of current research and funding in the area of nutrient management for horticultural crops. With the proposed Agricultural Operations Act, the industry, extension specialists and researchers recognize the large gaps in information needed to assist the Ontario horticultural industry in developing economically and environmentally sustainable nutrient management plans. The subcommittee put forward the following recommendation that was supported by the Ontario Soil Management Research and Services Committee:

Given the high potential impact that nutrient management planning legislation may have on the Ontario horticultural industry, this committee recommends that public funding programs be aimed at promoting and developing environmentally sustainable and cost effective nutrient management research.

The committee then reviewed the Operating Principles of OSMRSC that will allow the committee to function within the four-year cycle of the OASSC system and the University of Guelph/OMAFRA enhanced partnership. Committee reports will vary from development of a strategic plan in the final year of the cycle to implementation of the plan and updating research progress in the first three years of the cycle as a result of adoption of these operating principles. Successful operation of the committee will depend on full representation and updated research reports from all research organizations. A discussion of the current soil test laboratory accreditation process and soil test reporting format followed. It was decided that a working committee be developed to review the soil test lab accreditation program with representation from industry, AAFC, the university, OMAFRA and a producer. The working group is to review the accreditation process and the provision of OMAFRA accredited tests for soil test and plant samples as the default test unless otherwise requested. The discussion then focussed on how best to handle the large number of research recommendations received. It was decided that the executive would complete the organization of the recommendations and that the prioritization of the recommendations would be completed at a later date by e-mail. A discussion concerning the agricultural interests present in the federal 5NR-group report released July 2001. The committee felt that level of representation of agricultural interests in the assessment of nutrients and their impacts on the environment was inadequate and that OSWARSC should address this concern. The committee passed the following recommendation;

"That OSWARSC express concern to the federal 5NR group regarding the inadequate level of representation of agricultural interests in the development of the assessment 'Nutrients and their Impact on the Canadian Environment', released July 2001, and the ensuing action plan."

2001
ONTARIO SOIL MANAGEMENT RESEARCH RECOMMENDATIONS

Recommendation 1: Quantify the biological, physical and socio-economic effects of manure management, in part by developing an environmental index for N, and an appropriate environmental model that takes into account the influence of soil macropores on movement of materials through the soil.

Issue: Manure Management

BACKGROUND:

Environmental effects of manure may occur on the originating farm, or, more often, away from the farm in downstream watercourses and in the global atmosphere. Research is required to quantify the environmental costs of manure-handling activities to the farmer and to society. Likewise, there is a need to quantify the benefits to society, the costs to the farmer, and the net benefits (or costs) to the farmer and to society of the farmer adopting more environmentally benign manure-handling activities.

Source: Waste Utilization Subcommittee

Recommendation 2: Development of better manure and biosolid application systems to improve nutrient efficiency and reduce the impacts on environmental quality. Prediction of available N from organic materials added to the soil

Issue: **Manure Management**
Nutrient Use Efficiency

BACKGROUND:

Concentration of the livestock industry into larger production units creates new challenges in manure handling and application. Current research in Ontario addresses many issues associated with manure application, however, some areas of research require much more work. In particular:

Manure/biosolid application in no-tillage systems or to perennial field crops: With increased adoption of no-tillage systems in Ontario, methods and techniques of applying manure/biosolids to land to maximize the benefits and minimize the losses are required. Conservation tillage systems reduce soil loss and improve the quality of water flowing off of a field. However, losing the ability to incorporate manure may result in more manure remaining on the soil surface which may result in higher nitrogen (N) losses, more odours, potential manure/biosolid runoff and bacterial contamination of surface waters. Additional research is needed to better quantify environmental impacts of surface applied manure (surface runoff, tile drain contamination, volatilization), amount of incorporation that occurs following a rainfall, extent of insect problems (e.g. Cutworm) resulting from manure left on the soil surface, and crop yield implications. Research should determine the optimum methods, rates and timing of applying manure/biosolids in reduced tillage systems. This research would benefit farmers trying to incorporate no-tillage practices to save soil and improve soil quality (structure and organic matter) while

utilizing manure/biosolids as efficiently as possible.

P and K Fertility Levels with Respect to Nutrient Management Plans: Farmers continue to look for opportunities to apply manure/biosolids as a fertilizer source for crop production. Often, many years of over application has raised soil test levels of phosphorus (P) and potassium (K) to what is considered excessive by Ontario Soil Test. There is a need to know what impact of excessive fertility levels, specifically P and K, on agronomic crop production as well as potential environmental consequences. For example, excessive K levels in forages will have an impact on dry cow nutrition, but at what level will high K levels in soil have a detrimental effect on the environment and/or crop yields. The benefit of this research would be to help determine safe manure application rates based on all three nutrients (N, P and K).

Nutrient Release from Manure: The availability of nutrients from manure depends on the mineralization after application, as well as the magnitude of losses. These will both vary with the timing of manure application as well as the weather conditions following application. Better tools for the prediction of available nutrients from manure, particularly N, need to be developed. Non-fertilizer sources of N, such as manure, cover crops, residues and previous crops, all need more research to determine the amount of N being released to the following crop. Appropriate means for predicting the N contributions should also be developed. This is important for all crops, but in tobacco has the added impact on leaf quality.

Source: Field Crop Subcommittee
Soil and Water Quality Subcommittee
Waste Utilization Subcommittee
Tobacco Subcommittee

Recommendation 3: Crop rotation systems to enhance soil quality and improve crop productivity

Issue: Soil and Crop Management

BACKGROUND:
The selection of crops within a rotation can play a significant role in the overall productivity and quality of the soil. Recent changes in Ontario have increased the need for research in the following areas:

1) Maximizing Yields Under a Short Term Soybean Rotation: The economic climate in Ontario agriculture makes the growing of soybeans very attractive. Farmers in the province are beginning to grow soybeans in very short rotations (if they use rotations at all). Studies should be run to determine how to best maintain yields of soybeans. How long (or short) should soybean based rotations be to prevent the build-up of pathogens such as rhizoctonia root rot, soybean cyst nematodes, etc.? What is the impact of other rotational crops (such as canola) on soybean yields? Much work was done with corn and many of the problems that were studied for corn must be studied for soybeans as well.

2) Crop Rotation and Sequence Effects on Soil Quality: Many crop rotations and sequences have not been studied. For example, there appears to be reduced

yields of many crops grown after canola. Research should be conducted to determine the effects various crop sequences have on overall productivity and sustainability.

3) Cover Crops in Horticultural Systems: Cover crops are still used only rarely in fruit and vegetable production in Ontario. Research is needed to determine the best systems to incorporate cover crops into annual vegetable production systems and to determine the best sequences of crops in these systems. Also, ongoing trials and research are necessary to compare cover crop and organic amendments, and their effects on soil nematode populations.

1) Rotation Crops in Tobacco Production Systems: Preliminary work has shown the potential of rotation crops to suppress populations of root lesion nematodes during the tobacco production year and thereby reduce pesticide use in tobacco production. However, the immediate and future effects of the effects of growing sorghum, millet or marigolds in rotation with tobacco on leaf yield and quality and on soil and water quality have not been studied. Research is needed to determine the best management systems that incorporate these nematode suppressing crops into a tobacco rotation while maintaining soil cover in the non-tobacco producing part of the rotation.

Source: Field Crop Subcommittee
Horticultural Crops Subcommittee
Tobacco Subcommittee
Soil and Water Quality Subcommittee

Recommendation 4: Improving the management, productivity and profitability of field crop production by increasing our understanding of temporal and spatial variability of soil properties in agricultural fields.

Issue: Soil and Crop Management
Nutrient Use Efficiency

BACKGROUND:

Field variability of nutrient levels, pH, variable response to fertilizer and yields has created many new challenges to farmers. More research is needed into site specific agriculture that will allow us to predict areas of a field that require higher inputs and areas of a field that require lower inputs. Use of this information may allow us to keep more nutrients in the root zone and may lower cost of production of crops in Ontario. Strategies for optimizing inputs to deal with field variability are needed to optimize production on fields. The variables that affect yield most need to be identified along with cost effective, efficient ways of measuring those variables. With increased use of yield monitors in combines management of soil variability to reduce yield variability is becoming a greater issue.

In an informal study, seasonal fluctuations in soil P, K and pH levels have been observed in Ontario. The magnitude of seasonal fluctuation must be investigated and, if seasonal fluctuation is found, the causes must be studied. It also should be determined if the fluctuations are large enough to affect nutrient recommendations in Ontario and to devise methods of sampling so individual operators can minimize fluctuations in recommendations due to temporal fluctuations in soil test values.

With the release of new, pH sensitive herbicides and the growing realization in the agricultural industry of the variability of soil pH, increased emphasis should be placed on soil pH and liming research. Recent work has indicated that soil pH may not be corrected to the target levels with the addition of recommended rates of lime. Research is needed to assist in identifying those parts of a field with pH problems and to find appropriate and accurate methods of correcting the soil pH.

Growers are being bombarded with new technology in the horticulture industry. Research is needed to validate and adapt this new technology which includes such things as remote sensing, GPS mapping and yield monitoring.

Current research in Ontario is concentrating on N and varying N rates across the field. The effects of variable P and K fertilization, planting population, weed control and lime, to name just a few, on yield variability and profitability are currently unknown. Much more needs to be learned.

Source: Field Crop Subcommittee
Horticultural Crop Subcommittee
Soil and Water Quality Subcommittee

Recommendation 5: Identification of sources of surface water contaminants and to develop and field test techniques to identify sources of contamination

Issue: Manure Management

BACKGROUND:

Beach closures are the most visible symptom of bacterial contamination of surface waters, however, it is seldom clear whether the bacterial source is livestock manure, septic tanks, sewage bypass in sanitary sewers, or wildlife droppings. Identifying the source of contamination would allow the targeting of scarce resources to those cleanup and prevention programs that will have the most impact. The effects of manure handling systems and their effects on the fate and longevity of pathogens in liquid and solid manure is required.

Along with bacteria, manure can also contain protozoa (e.g. *Cryptosporidium*) and EDC's (Endocrine Disrupting Compounds), although manure may not be the only source of these contaminants. Identifying the sources of these contaminants will have similar benefits.

Source: Waste Utilization Subcommittee
Soil and Water Quality Subcommittee

Recommendation 6: Development of improved water and nutrient management to improve water-use efficiency and water quality.

***Issue:* Nutrient Use Efficiency**

BACKGROUND:

Recent dry weather and increased use of supplemental water to produce crops on coarse-textured soils has reduced water levels in ponds, wells, creeks and the Great Lakes. The demand in many areas exceeded the supply available. Stream flow rates, water depths, and oxygen concentrations declined to very low levels and can have devastating results populations of fish and other aquatic life. Other water users and environmental groups have raised concerns regarding what they view as an excessive use of a public resource by agriculture. Due

to water shortages, provincial ministries are enforcing water use permits more strictly and growers are under the ever-watchful eye of the public as they irrigate their crops. Research to integrate land, water and crop management for the mutual improvement of crop production and ecosystem health is essential for sustainability.

Even though southern Ontario has a temperate humid climate, irrigation has long been recognised as a valuable farm management practice that can greatly improve crop yield, maturation, and quality. Natural rainfall from late May to early September is inadequate for some crops and frequently poorly distributed over the growing season. Many crops cannot be successfully grown on coarse-textured soils without supplemental irrigation water in most years and growers in increasing numbers are using irrigation as a crop management technique. More than 56,000 ha of field and vegetable cropland (tobacco ~ 25,000 ha, potato ~ 14,000 ha, vegetables 57,000 ha in total ~ 17,000 ha irrigated) is irrigated in Ontario each year. The vast majority of this land is irrigated with high-pressure sprinkler or gun systems. Irrigation requirements vary widely with season and crop, but typically range between 2.5 and 15 cm per season.

In view of predictions based on global warming trends, adapting to a drier climate will likely become a necessity and irrigation water will have to be used more efficiently in the near future. Current irrigation methods are aimed at developing crop production systems that incorporate overhead irrigation methods for improved crop production. However, these methods are less efficient than newer micro-irrigation techniques that could increase water-use efficiency by reducing loss to evaporation, improved scheduling and greater capacity for control of internal drainage. Fossil fuel consumption and associated costs to run the currently used high-pressure travelling guns and sprinkler systems would also be reduced. These systems can also reduce incidence of disease as compared with conventional irrigation. Furthermore, fertigation provides opportunities to use nutrients more efficiently and improve water quality through better timing and placement of nutrients and reduced losses by deep percolation and erosion. However, little is known about appropriate fertilizer sources, rates and timing. The use of subirrigation, micro-irrigation (trickle irrigation), controlled drainage, and fertigation all have shown some promise in Ontario. More research is needed to determine the economic and environmental sustainability of these crop production practices.

The greatest environmental issue of the greenhouse industry is fertilizer leachate. In the area of flue-cured tobacco seedling production in float trays, determination of methods to utilize nutrient enriched water in an environmentally friendly manner and further investigation on the nutrient requirements for producing high quality seedlings are needed. Other concerns include the effects of various nutrients, including high soluble salts, on seedling germination, growth and hardiness. Ongoing research is necessary to determine nutrient needs in greenhouse systems for optimum production and recycling systems that will reduce or eliminate fertilizer effluent from greenhouses.

Source: Horticultural Crop Subcommittee
Field Crops Subcommittee
Tobacco Subcommittee

Recommendation 7: Overcoming factors limiting crop production when growing corn, horticultural and flue-cured tobacco crops with reduced tillage.

Issue: **Soil and Crop Management**

BACKGROUND:

The adoption of no-till or reduced till appears to have leveled off in the past two years. Some of this can be traced to economics (farmers are more risk averse when commodity prices are dropping or production has been affected by weather). Equally significant are the unanswered questions (real or perceived) concerning management of reduced tillage in specific situations. As the size of farming operations increases, the tendency is to use the lowest common denominator (the tillage system which works on the widest range of soils) instead of the most appropriate system for a specific field. This can lead to soil degradation and water quality problems.

Fine Tuning No-till Systems: Although there has been much work done relating the effects of tillage systems on the production of crops in Ontario there are still unanswered questions. Producing no-till corn on fine textured, wet soils is still a challenge. The effects of planting in wet conditions with no-till and reduced tillage have not been addressed. Research should be continued on improving the no-till system and making it more adaptable to specific problem soils.

Managing Wheat Residue: Additional research is required to overcome some of the problems with planting no-till corn after winter wheat. Farmers have identified reduced emergence and plant stands and reduced yields related to growing no-till corn after winter wheat. Research to investigate residue management after winter wheat should continue. Methods of coping with the increased residue on the soil surface and cooler, moister seedbed conditions must be developed.

Lime application: Lime issues related to no-till crop production should also be addressed. Lime is relatively insoluble and immobile in the soil. In no-till production when the option of incorporating lime with tillage is no longer available, the efficacy of lime additions is not well documented.

Reduced Tillage Systems for Vegetable Production: In the industry there has been little adoption of reduced tillage systems for vegetable production. Research is still needed to identify the level of tillage reduction and the effect of plant residue on vegetable yields and quality for Ontario conditions and soils.

Reduced Tillage Systems for Tobacco Production: Reduced tillage systems in coarse-textured soils used for tobacco production have had a low rate of adoption. The use of reduced tillage for the production of flue-cured tobacco could potentially reduce erosion, soil degradation and water quality problems while maintaining yield and quality.

Source: Field Crop Subcommittee
Horticultural Crops Subcommittee
Tobacco Subcommittee

Recommendation 8: Determine the NPK fertility impacts on functional food, nutraceutical and other quality aspects of horticultural and field crops, to provide a basis for management of value-added crop production with increased profitability and reduced environmental impact.

Issue: Nutrient Use Efficiency

BACKGROUND:

Producing crops that address consumer demand has huge potential to generate new revenues for growers. Crop quality and safety are becoming more important to consumers. In many cases, nutrient availability can have an impact on crop quality and may provide the opportunity for added value. Current sales of functional foods and nutraceuticals across North America exceed $6 billion. Food industry consultants have estimated the potential future market as high as $250 billion, of which the Ontario retail share could be $8 billion or more.

Although Ontario crops are known to contain a wide variety of phytochemicals with nutraceutical properties, the impact of basic NPK fertilizer management on the levels of these compounds is not well known, and could potentially be significant. For example, one preliminary project has confirmed a positive relationship between soybean isoflavone concentrations and the level of potassium fertility. Many more phytochemicals in a range of crops could be examined for the separate and combined effects of nitrogen, phosphorus and potassium, to determine optimum levels of fertilization that produce crops of improved healthful quality. These crops include soybeans, corn, cereals, canola, and horticultural crops. Such research has good potential to improve agriculture's image in terms of producing healthful foods, and needs to be conducted with simultaneous evaluation of the environmental impact of optimum levels of applied nutrients.

Specific knowledge gaps include:

Horticultural and flue-cured tobacco crops lack a database for calibration of fertilizer requirements to soil test levels, for both yield and quality aspects. Further research into both rates and timing of applications is essential for fruit, vegetable and flue-cured tobacco crops, particularly where new cultivars and hybrid varieties are grown. To minimize environmental impacts, research is needed to develop a nitrate-N test for muck (organic) soils and quick test technology for nitrate tests in both mineral and muck soils. Such technology to minimize nitrate levels in both produce and in groundwater is used in other parts of the world, particularly in Europe, but has not been well studied in Ontario. Crops of particular interest for their nutraceutical content include tomatoes, broccoli, cabbage, cauliflower, apples, grapes, ginseng and garlic.

Field Crops: Nitrogen recommendations for corn require a full review, to better integrate information from the soil nitrate test, to account for changes in modern higher-yielding and genetically modified (e.g. Bt) hybrids, and to evaluate impacts on protein quality and carotenoid content. Regional differences in nitrogen recommendations for corn need to be addressed, to ensure groundwater protection from nitrate leaching. The effects of potassium and chloride on cereals, particularly winter wheat, and quality-reducing diseases require more research. Cereal phytochemicals that may be impacted by NPK include beta-glucans, saponins, terpenoids and phytin. Soybean nutraceuticals include saponins and lignans in addition to isoflavones. Canola NPK recommendations lack a database sufficient for calibrating fertilizer requirements to soil test levels and evaluating

effects of fertility on oil quality.

SOURCE: Field Crop Subcommittee
Horticultural Crop Subcommittee
Tobacco Subcommittee

Recommendation 9: Quantify the emission of greenhouse gases and the potential for C sequestration from agricultural activities, particularly in relation to soil, crop residue and organic amendment management.

Issue: Nutrient Use Efficiency
Soil and Crop Management
Manure Management

BACKGROUND:

Soil organic matter (SOM) is a key attribute of soil quality. In mineral soils, organic matter not only serves as a major terrestrial pool for C, N, P and S but many key properties associated with soil quality, including nutrient availability, aggregate stability, favourable water relations and resistance to erosion are directly related to the soil organic matter content. Soil organic matter contents in soil are a result of the complex biochemical interaction between substrate additions of C and N from plant, animal, and microbial residues and in fertilizers and losses of C and N resulting from microbial decomposition and erosion. A number of studies have shown a direct relationship between rates of C addition and soil C levels. Organic matter decomposition, on the other hand, is influenced by numerous physical, chemical and biological factors controlling the activity of soil organisms. Understanding the factors (climatic, edaphic, and management factors) governing the changes in SOC pool sizes is crucial for assessment of the essential aspects of soil quality and its response to management as well as assessing the potential for C sequestration in agricultural soils.

Past considerations of SOM and how it is affected by management practices have largely reflected the importance of SOM to soil fertility and crop production. More recently, interest in SOM and its relationship to agricultural management has developed with respect to its role in the worldwide C budget and worldwide climate change, another important quality of soil. Soils of North America account for 22% of the world's terrestrial carbon pool. The improved cropland (excluding pastureland) in Canada is 45 million ha with a total soil carbon pool to a depth of 1 metre of 6 Pg. Estimates of historic loss of soil organic matter from cultivated soils in Canada are about 1 Pg. In Ontario, where most of the arable soils were first cultivated within the last 150 years, the conversion of native forests to arable agriculture resulted in a loss of soil organic C of about 25-35%. The results of some studies in Canada have suggested that this decline in soil C resulting from the conversion from virgin land to arable cropland has subsided and suggested that the current changes observed in soil C dynamics are a function of current management practices. However, it is uncertain whether Ontario soils are functioning as a net source or sink of atmospheric CO_2.

Agriculture has the potential to be both a source and a sink for greenhouse gases, but the impact of various agricultural activities on the emission of greenhouse gases is largely unknown. There is a need to better understand the role that agriculture plays in the production of greenhouse gases, and the management techniques that could reduce this production. There is an urgent need for information on the emissions of CO_2, CH_4 and N_2O from soil, fertilizer materials and organic amendments, such as manure. Research is needed to identify the carbon-nitrogen dynamics in different textured soils managed under different cropping and soil management schemes to allow a more thorough understanding of the implications for

sustainable production in Ontario soils and possible management tools to reduce greenhouse gas emissions.

Source: Field Crop Subcommittee
Waste Utilization Subcommittee
Tobacco Subcommittee

Recommendation 10: Determining key soil quality characteristics for the development of improved soil management systems

***Issue:* Soil and Crop Management**

BACKGROUND:

Soil quality is a vague and relative term that must be defined and soil chemical, physical and biological attributes must be developed. Soils provide many functions, and when one or more factors are constrained then crop productivity and environmental quality are compromised. A list of key parameters must be established and optimal ranges of measurements defined. For example, physical properties may consist of water transmission rates, storage and aeration status; chemical properties may include total and labile organic matter, etc. Long-term studies could be used to develop and test these biological, chemical and physical indicators and these could then be applied to short term studies to evaluate their potential as a sustainable management tool.

Soil quality should be one of the components of any research into crop management, manure management or tillage systems, so this research can be better extended to other areas and cropping systems. A considerable amount of research is performed at the plot and farm scale. Results of this research help support an economically and environmentally sustainable industry, however, increasingly society is requesting that research support decision making at broader scales. Consequently, there is a need to scale detailed site-specific research up to provide more rigorous regional assessments. For example, better understanding of cross scale process relationships will allow us to more effectively apply plot/field/farm scale research to address questions being asked at scales appropriate for policy development and resource management (region/nation). To meet this challenge research is required to develop better tools, techniques and error assessment for scaling information and knowledge. Research is also required to examine the integration of land resource information with other biophysical and socio-economic data to create resource management models and decision support for land use planning.

Some of the key issues that require scaling research include:

Water Quality
Nutrient Management
Inherent Nutrient Capacity of the Landscape
Greenhouse Gas Production and Mitigation
Carbon Inventory and Sequestration

Source: Soil and Water Quality Subcommittee

Recommendation 11: Improving secondary and micronutrient fertilization field and horticultural crops

Issue: **Nutrient Use Efficiency**

BACKGROUND:

There has been an increase in the use of secondary and micronutrients (both foliar and soil applied) in the horticulture industry. Research is needed to evaluate the effectiveness of these nutrients on the yield and especially quality of horticultural crops.

Boron is occasionally deficient for some field crops in Ontario (particularly alfalfa), while other field crops are highly sensitive to boron and high boron levels reduce yields. Research is needed to develop an effective soil test that can be used as a predictor for Ontario soils. Research is also needed into the management of boron for crop production, both in deficient and excess soils.

Although canola growers are experimenting with applying micronutrients, there has been little or no research into the micronutrient requirements of canola.

Calibration research should be conducted with respect to the levels of calcium and magnesium in Ontario soils. There is currently a gap in the data used for recommending calcium and magnesium application to Ontario soils.

Tobacco growers are interested in the effects of calcium when applied at transplanting, side-dressing, and/or as a foliar application with sucker control on agronomic performance including the incidence of bruise green.

Source: Field Crop Subcommittee
Horticultural Crop Subcommittee
Tobacco Subcommittee

Recommendation 12: Study the fertility requirements of flue-cured tobacco production under the higher plant populations used in automated harvesting technologies

Issue: **Nutrient Use Efficiency**

A current trend occurring in the production of flue-cured tobacco is to switch to automated harvesting from the traditional hand-priming method. This is being driven by several factors, such as increasing labour costs, difficulty in finding and maintaining labourers for the entire harvest season, and increased crop size per grower. Plant populations with automated harvesters can be as much as 20% greater than that used for traditional hand priming. Current fertilization recommendations and anticipated tobacco quality and yield are based on plant populations used with traditional harvesting methods. Nitrogen, phosphorus and potassium requirements for higher plant populations need to be investigated to determine the effects of fertilizer management at higher plant populations on yield and quality of flue-cured tobacco.

Source: Tobacco Subcommittee

Recommendation 13: Management of organic matter amendments on horticulture crops and flue-cured tobacco production systems

Issue: **Soil and Crop Management**

BACKGROUND:

There is ongoing interest in using various organic amendments as part of a crop production system, both by farmers and by the producers of the amendments. There are potential benefits to using these materials, both as a fertilizer and as a way to increase soil organic matter content. There are, however, potential problems with heavy metals, salts or N tie-up.

Continuing research is necessary to determine the effectiveness and adaptability of these amendments to horticultural and flue-cured tobacco production.

Methods must also be developed to evaluate metals and other contaminants in sewage biosolids, paper waste, and manure, including how organic matter affects the transport of contaminants and their uptake by plants.

Source: Horticultural Crop Subcommittee
Waste Utilization Subcommittee
Tobacco Subcommittee

Recommendation 14: To investigate the effectiveness of urease inhibitors and fertilizer enhancers as a means of increasing fertilizer use efficiency and crop productivity

Issue: **Nutrient Use Efficiency**

BACKGROUND:

Ideally none of the inputs used in agriculture should leave the root zone of a field. This, however, is not always the case. Research should be conducted into improving fertilizer efficiency so that nutrients are maintained in the root zone while crop yields are optimized. This includes improving the ability of detecting plant available N from organic sources using soil testing. Extensive research in the US and Canada has shown significant reductions in ammonia losses from urea using urease inhibitors. Use of these products could assist greatly in matching application rates of urea to crop demand, and reducing losses of N in the form of nitrate as well as ammonia. Further research to support the use of urease inhibitors in Ontario would assist the adoption of such products for use in Canada.

There are some products being promoted as enhancers to fertilizer uptake (e.g. Amisorb). Little independent Ontario research has been conducted on the efficacy of fertilizer enhancers. Research to investigate the usefulness of fertilizer enhancers for Ontario farmers should be done.

Source: Field Crop Subcommittee

Recommendation 15: Development and calibration of multi-element extractants suitable for Ontario soils.

Issue: **Soil and Crop Management**
Nutrient Use Efficiency

BACKGROUND

The current accredited soils tests in Ontario require four different extractions for a basic soil analysis, as well as the use of wet chemistry to measure the concentration of the nutrients in the extract. This adds costs to the operation of a soil test lab, and ultimately to the farmers of

Ontario. Other provinces and states are using the Mehlich 3 extractant for soil analysis, but it is not appropriate for Ontario because of the large areas of alkaline soils. Development of a single multi-nutrient extractant for soil testing would be beneficial to both the soil test labs and the farmers of Ontario. Lab procedures would be simplified, leading to lower costs and fewer errors, there would be less toxic waste material produced, and the tests could cover a number of nutrients not currently tested. These developments would help make site specific crop management and manure management more economical.

This research should look beyond traditional soil sampling and analysis. In Quebec and Saskatchewan, development of exchange resin based soil tests is proceeding. Research on environmental impacts of P losses is also revealing alternative tests for soil P that may be more effective in predicting crop P requirements.

Source: Soil Test Lab Subcommittee

Research Studies Addressing 2001 Research Recommendations

Recommendation 1: Quantify the biological, physical and socio-economic effects of manure management, in part by developing an environmental index for N, and an appropriate environmental model that takes into account the influence of soil macropores on movement of materials through the soil.

OMAFRA has initiated an N benchmark that tracks the accumulation of NO^-_3-N and NH^+_4-N during the early part of the growing season (April to late June) at 30 sites across Ontario. The aim of the project is to provide better information on the impact of sampling time on N recommendations, particularly where manure or legumes are present. N response trials are also included at each site.

OMAFRA is conducting an N verification project to verify whether the NMAN computer program provides the proper ranking of risk of "leachable" N in different farming systems. Samples are being taken from 130 field crop sites, and 70 horticultural crop sites, with various rotations, and manure uses, in late fall, early spring and pre-plant N test time.

The Soil Resource Group, Upper Thames Regional Conservation Authority, and Agri-Food Labs are investigating the utilization of manure-N by crops, movement of manure-N to drain tiles and manure application using temporal and spatial variability (GPS) based on soil test N.

Recommendation 2: Development of better manure and biosolid application systems to improve nutrient efficiency and reduce the impacts on environmental quality. Prediction of available N from organic materials added to the soil

U of G (Ridgetown) is investigating the impact of manure application on soil test P levels and plant available P.

U of G (Ridgetown) is conducting a study to assess the effects of phytase, enviropig and a low phytate diet on P availability and loss from manure applications.

AAFC (SCPFRC) is investigating the crop response to side-dress manure application rates. Methods and environmental impacts to improve prediction of manure sidedress rates based on the pre-sidedress nitrate test (PSNT), corn yield response curves to sidedressed liquid manure in relation to the PSNT, transfer of contaminants (NO^-_3-N and bacteria) to drainage waters, and residual soil N are monitored.

AAFC (SCPFRC) is conducting a study to determine nutrient movement to groundwater following pre-plant manure injection for no-till corn in sandy soil. Capacity of overseeding cereal rye into standing corn to control nitrate leaching in manured systems is tested.

Recommendation 3: Crop rotation systems to enhance soil quality and improve crop productivity

U of G (Guelph) is assessing the effects of crop rotations on yield and soil properties.
U of G (Ridgetown) is performing studies to determine the effects of various intensities of soybeans in a rotation on the soil properties and crop yields.
U of G (Guelph, Ridgetown) and AAFC (GPCRC) are investigating crop rotation effects on corn growth and yield.

Recommendation 4: Improving the management, productivity and profitability of field crop production by increasing our understanding of temporal and spatial variability of soil properties in agricultural fields.

AAFC (ECORC) is involved with a collaborative study to investigate and develop techniques to scale plot and field scale research to scales relevant for municipal and provincial policy.
AAFC (ECORC) is also collaborating with OMAFRA and Prescott OFA to develop regional scale nutrient capacity, nutrient balance, and an analysis of the impact of current land use policies on the potential for livestock intensification/expansion.
AAFC (ECORC) is working to develop crop-based indicators for monitoring spatial variability and corn nitrogen management. The work involves monitoring canopy reflectance (measured with CropScan) and leaf greenness (i.e., leaf chlorophyll content using SPAD-502) during early stages of corn development in comparison with soil nitrate changes.
OMAFRA is conducting a study that is investigating application of site specific technology to horticultural crops (strawberries, peppers, and cucumbers). The project is monitoring soil fertility, weed pressures, disease pressures and insect populations.
U of G (Ridgetown) is working on ways of delineating management units for site specific rates of N application.
U of G (Ridgetown) has a project to determine yield stability patterns in field and methods of delineating management units in fields.

Recommendation 5: Identification of sources of surface water contaminants and to develop and field test techniques to identify sources of contamination

AAFC (SCPFRC) is studying the effect of liquid swine manure application methods and rates on the production, persistence and off-site movement of endocrine disrupting compounds and NO_3^--N in surface and ground waters.

Recommendation 6: Development of improved water and nutrient management to improve water-use efficiency and water quality.

AAFC (SCPFRC) initiated a project in 2001 to investigate the use of micro-irrigation techniques on vegetable production. The project compares water-use efficiency and leaching losses in surface trickle and subsurface trickle irrigation with overhead sprinkler irrigation. Nutrient-use efficiency in systems using conventional soil applied dry granular fertilizer blends applied at OMAFRA recommended rates and using fertigation with rates applied above-, below- and at the recommended rates are also being compared in this study.
U of G (Vineland, Guelph) is investigating nutrient recycling via recirculation of water and fertilizer solutions in the production of nursery stock. Commercialization of the process is being pursued based on the success of the early phases of this study.
AAFC (GPCRC) has a project that investigates the integration of land, water and crop management systems for the mutual improvement of crop production and wildlife habitat.

Recommendation 7: Overcoming factors limiting crop production when growing corn, horticultural and flue-cured tobacco crops with reduced tillage.

U of G (Guelph) and OMAFRA are examining the impact of fall zone tillage on corn growth and the application of fall and spring applications of P and K in these systems. The goal is to identify a combination of tillage and NPK management practices that will lead to a reduction of impact of corn production on water quality while overcoming limitations to reduced tillage corn production.
U of G (Guelph) has a project to identify soil-related limitations to corn production under no-tillage.

U of G (Guelph, Ridgetown) and OMAFRA researchers are evaluating the use of cover crops and reduced tillage systems for weed suppression in strawberries. This project is a first step towards developing an integrated approach to weed management in strawberry production.
AAFC (GPCRC) is investigating the use of reflective mulch in warm season crops.
U f G (Guelph, Ridgetown) and AAFC (GPCRC) are investigating the use of zone tillage in corn production.
U of G (Ridgetown) is determining the effects of various tillage systems on corn growth.
OSCIA has a project to assess the effects of fall deep tillage on corn production.

Recommendation 8: Determine the NPK fertility impacts on functional food, nutraceutical and other quality aspects of horticultural and field crops, to provide a basis for management of value-added crop production with increased profitability and reduced environmental impact.

AAFC (ECORC) and the U of G (Kemptville) are evaluating field scale methods to identify nitrogen management units on the basis of residual nitrogen and soil structure in corn production systems.
AAFC (ECORC) is comparing the effects of different processing methods of soil samples on recovery of soil mineral N content.
AAFC (GPCRC) is investigating nitrogen management for fresh market sweet corn grown with plastic mulch.
U of G (Guelph) is investigating the yield response of corn and soybeans to intensive management systems across a landscape. Measurements of crop phenology, leaf area index, crop biomass at several growth stages, characterization of soil fertility and regular monitoring of soil temperature and water in high-input treatments (greater than recommended rates of P and K, deep placement and high plant density) will be compared to grower practices.
U of G (Guelph) and AAFC (GPCRC) are conducting a co-operative trial with researchers at Purdue on soil fertility, disease factors and genetic effects on soybean isoflavones. Preliminary results indicate that K fertilization in low K soils have a positive effect on yield and isoflavone concentration. Similar results were obtained at one of the test sites with high soil K values.
U of G (Guelph) is conducting a trial to determine the effect of P nutrition on a range of secondary metabolites and phytochemicals in apples and tomatoes. Treatments include both soil applied P and foliar applications.
U of G (Ridgetown) and AAFC (GPCRC) are carrying out trials to determine the rate of reaction and depth of influence of surface and broadcast limestone and to assess its effect on soybean and corn yield response to applied nutrients.
AAFC (GPCRC) is performing a trial to determine whether chloride or magnesium applied with K fertilizers influence soybean response to K and to determine whether Ontario soybean varieties differ in response to K and sources of K.
U of G (New Liskeard) is investigating nitrogen application rates for canola production.
U of G (Vineland) is determining the availability of nitrogen in high density peach orchards and foliar nutrient supplements for grapes, peaches and nectarines.
U of G (Bradford) is investigating N rates, sources and times of application on yield, quality, storability and onion thrip development in yellow cooking onions.
U of G (Bradford) is investigating N rates on yield, quality, storability and disease development in carrot. Analysis of crop N status is being monitored in this project.
U of G (Bradford, Simcoe and Guelph) is investigating N application rates on disease and insect pressure on onions, carrots and cabbage.
U of G (Vineland, Guelph) have a collaborative project investigating different fertilizer materials (particularly slow and controlled release products) and delivery systems on nutrient availability, loss and plant response for various nursery crops.

U of G (Guelph, Ridgetown) are investigating crop-based indicators of corn N requirements and quantifying the maximum economical rate of nitrogen (MERN) for corn. This project is also comparing use of the quadratic and quadratic plateau models to determine MERN.
The Canadian Tobacco Research Foundation (CTRF) is investigating the effects of nitrogen application rates, topping heights and cultivar selection on leaf quality and yield.

Recommendation 9: Quantify the emission of greenhouse gases and the potential for C sequestration from agricultural activities, particularly in relation to soil, crop residue and organic amendment management.

AAFC (ECORC, SCPFRC and GPFRC) and the U of G (Guelph) have a collaborative research project investigating C sequestration. The project investigates the extent of C sequestration that has occurred on long-term no-till sites, the ease with which this C is lost to the atmosphere if tillage is reintroduced, and the amount of N_2O that is emitted from a fine textured soil under no-till (in relation to conventional till). From the data generated, the Century model will be refined for simulating C and N dynamics.
U of G (Guelph) is working on potential greenhouse gas emission from manure and different application methods.
U of G (Ridgetown) is investigating the changes in nitrogen status and greenhouse gas emissions during the composting process when liquid hog manure is composted with various carbon materials (including solid beef manure).
AAFC (GPCRC) is determining the impacts of various soil amendments on on soil C and N in various tillage systems.
AAFC (GPCRC) is investigating the effects of crop rotation and fertilization practices on C sequestration.
AAFC (SCPFRC) is assessing the effects of changes in cropping and tillage systems on soil C dynamics.

Recommendation 10: Determining key soil quality characteristics for the development of improved soil management systems

A project involving personnel from AAFC (ECORC) and the U of G (Kemptville) is aimed at characterizing the effects of tillage and improperly timed mechanical field operations (i.e. 'best' vs 'worst' management) on soil structural properties, oxygen concentration in the soil profile, CO_2 flux and corn yields.
AAFC (SCPFRC) initiated a project in 1999 that is aimed at identifying key biological and chemical soil quality parameters and their changes in time with different management practices.
AAFC (SCPFRC) is currently assessing the impact of transgenic crops on soil quality and function. Assessment of soil biology (bacteria, fungi, mites, springtails, earthworms, and surface-active beetles), functions (C and N dynamics) and the persistence of transgene protein products in soil are being monitored over the 3-year project.
AAFC (GPCRC) is investigating the hydraulic and aeration characteristics of soil under never cropped or cultivated native forest woodlot (WL), no-tillage (NT) and conventional moldboard plow tillage (CT). The objectives of the study are to determine the extent to which annual cropping has degraded the soil hydraulic and aeration characteristics, and to obtain information on how these characteristics might be improved and maintained in annually cropped soils.

Recommendation 11: Improving secondary and micronutrient fertilization of field and horticultural crops

No research was identified in this area by subcommittees.

Recommendation 12: Study the fertility requirements of flue-cured tobacco production under the higher plant populations used in automated harvesting technologies

No research was identified in this area by subcommittees.

Recommendation 13: Management of organic matter amendments on horticulture crops and flue-cured tobacco production systems

Ongoing research on the use of various organic waste materials in the horticultural industry include the following projects:
U of G (Guelph, Vineland) are investigating uses of the organic rich biosolid by-product of an anaerobic digestion waste management system for use as an amendment in rooting mixes and growing media for the horticultural industry.
U of G (Guelph, Vineland) are investigating uses for ready-to-use potting mixes prepared from composted pine bark. Results suggest that there is a greater potential for the use of composts and organic wastes in the production of nursery stock.
AAFC (SCPFRC) is investigating the use of various organic amendments in potato production. The use of organic amendments has proven to be extremely useful in managing soil fertility and potato scab. The project is currently investigating the mode of action of these products. This work is aimed at improving the formulation of these amendments so that the rate of application can be reduced while making these materials more effective in different soils.

Recommendation 14: To investigate the effectiveness of urease inhibitors and fertilizer enhancers as a means of increasing fertilizer use efficiency and crop productivity

OSCIA are investigating the usefulness of Agrotain, a urease inhibitor, for spring wheat and corn production.

Recommendation 15: Development and calibration of multi-element extractants suitable for Ontario soils.

No research was identified in this area by subcommittees.

Appendix I - Sub-Committee Reports

2001 Ontario Soil Management Research and Services Committee

Annual Meeting

Minutes

The annual meeting of the Ontario Soil Management Research and Services Committee was held on June 12 at AAFC, London.

Attendance:

Ron Beyaert	Bill Ingratta	Marcel Anseeuw
Craig Drury	Adam Hayes	Sid Ryzebol
Dan Ramer	Christine Brown	Ed Gregorich
Virginia Marcille-Kerslake	Anne Verhallen	Doug Young
Christoph Kessel	Tom Bruulsema	Paul Brine, ERLD

Regrets: Pat Feryn, Keith Reid, John Rowsell, Bill Curnoe, Ivan O'Halloran

Motion to Approve Agenda: (Young, Brown) Carried

Adoption of 2000 Annual Meeting Minutes: (Bruulsema, Drury) Carried.

Sub-Committee Reports:
Field Crops - Doug Young
Report attached.

1 research priority was dropped

Comments: - with the changes to the OASCC system there is need to have full representation from all research areas i.e. AAFC or subcommittee chairs will have to be pro active and ask for reports or info from all unrepresented groups. Ron Beyaert is to write a memo to AAFC regarding the reporting method. The current system is not conducive to this committee function and the feeding in of information

Motion to accept report: (Young, Brown) Carried.

Hort Crop Subcommittee – Christoph Kessel
Attached.

Commented that similar to Ron's comments several key researchers were missing from the annual sub committee meting i.e. Albert Liptay - fertigation, Ron B/Bonnie Ball - irrigation, John Warner - N on tomatoes, John O'Sullivan cucurbits and no -till

Response to letter to Ron B re nutrient management planning - asking for consideration during the review of plants/environmental program at University of Guelph

Comment from Paul Brine - there is a Plants Program review this year - involves above ground the Environment Program will be reviewed in 2 years which will involve below ground

Motion to accept report: (Ramer, Bruulsema) Carried.

Tobacco Subcommittee Report - Dan Ramer
Report attached. Research is only done on flue-cured tobacco.

Motion to accept report: (Young, Hayes) Carried

Waste Utilization Subcommittee – Christine Brown
Chris keyed in on the need for positive progress concerning the utilization of waste materials.
Key concerns were heavy metals in manures, ie. Copper from weaner operations and zinc from poultry operations.
AAFC – working on pig manure composts/GHG emissions, and mineralization studies on composts (Craig Drury).
Claudia Wagner-Riddel and Ron Fleming, and others, working on gaseous emissions from composts.

Motion to accept report: (Drury, Ryzebol) Carried.

Soil Test Lab Subcommittee – Virginia Marcille-Kerslake
Report attached.

Research priority is the same with the addition of a lit review for a beginning for the multi nutrient extractant

Discussion surrounding funding and leadership for work on multi nutrient extractant - the point is to identify a researcher and/or projects and the labs need to put up some money

Motion to accept report: (Bruulsema, Drury) Carried.

Soil & Water Quality Subcommittee – Doug Young (secretary)
Report attached.

There was some discussion of Dan Reynolds' work with infiltrometers and soil quality.

Motion to accept report: (Bruulsema, Bowman) Carried.

Other Issues:

Comment from Ian Jarvis concerning the need to take field and plot scale information to levels more appropriate for land use planning. Need to characterize/quantify change in soils in landscape e.g. soil type has changed Guelph loam after intensive management/erosion no longer exists i.e. Ap over C but no B layer
Ian to provide "blurb" to Ron for addition - makes a better fit with Soil and Water Quality Subcommittee - Ian to be added to Soil and Water Sub committee

Service rec. - Ian - soil database - dealt with at next level as an emerging issue

Station reports were referred to the end of the meeting if there is time

Ron to develop emerging issues and to circulate back

Committee Operations:
Ron reviewed the Draft outline of how this committee is to operate i.e. 4 year cycle and how the sub committee report format works

Year 4 the format is very different - sub committees will gather what has been done to address the research recommendations and relate to relevant OSWARSC issue list

Do these committees have a role as a public advocate to respond to newspaper articles? - Raised by Tom Bruulesma - consensus was - NO. Tom to create some wording for a recommendation that representation of agricultural interests needs to be increased.

Changes in publications:
Publication 296 - production and pesticide application recommendations have moved to two different publications plus factsheets

- Pub 811 Field Crop Agronomy Guide - updated every 4 to 5 years - $20
- Pub 812 Field Crop Protection Guide - biennial publication - $10

Discussion of side dress N application - Don King/Greg Wall have data that potentially may support Beauchamp's data set re revision of pre sidedress factor. No change at this time, but this issue needs to be dealt with before next revision of the Agronomy Guide.

1. Publication 298 Tobacco Production Recommendations
Change in wording Chpt. 2 Field Fertility - Nitrogen "Avoid excessive use of nitrogen on tobacco and application of nitrogen after last cultivation,"

Motion to accept new wording: (Anseeuw, Ramer)
The economic effect was questioned and a request was made for data. The motion will be emailed to the group with the data set.

2.There is a new OMAFRA publication on greenhouse vegetable production

- reviewed by the Greenhouse and Protected Crops Sub Committee due to expertise

- letter from that sub committee to be sent to OSMRSC chair in order for recommendations to be accepted by OSMRSC

3. Publication 811
Regarding manure risk assessment - Chris Brown to send a draft to Ron B to be sent out to all for review
Extended discussion concerning NMan regarding review of the recommendations

Soil Test Accreditation

- currently we don't accredit out of province labs
- discussion of accreditation process by Virginia and outline of accreditation testing
- Bill Ingratta explained the need to review the accreditation program and why

Motion: That OMAFRA accredited labs always provide the OMAFRA accredited test for soil and plant samples (Drury, Kessel).
Addendum - add unless otherwise requested (Brown)

Now reads as:
Moved that the review committee consider that the OMAFRA accredited labs provide the OMAFRA accredited tests for soil test and plant samples as the default test unless otherwise requested.

Motion to table the motion on floor (Ingratta, Bruulsema)
Vote 9-1, Carried

Motion:
That a working committee be developed to review the soil test lab accreditation with representation from industry, AAFC, the university, OMAFRA and a producer.
(Marcille-Kerslake, Ingratta) Carried

Directions - the committee chair to be Keith Reid - need to bring the names back to the OSMRSC executive

Research Recommendations:
Recommendation 1:Quantify the biological, physical and socio-economic effects of manure management, in part by developing an environmental index for N, and an appropriate environmental model that takes into account the influence of soil macropores on movement of materials through the soil.

Recommendation 2:Development of better manure and biosolid application systems to improve nutrient efficiency and reduce the impacts on environmental quality. Prediction of available N from organic materials added to the soil

Recommendation 3:Crop rotation systems to enhance soil quality and improve crop productivity

Recommendation 4: Improving the management, productivity and profitability of field crop production by increasing our understanding of temporal and spatial variability of soil properties in agricultural fields.

Recommendation 5: Identification of sources of surface water contaminants and to develop and field test techniques to identify sources of contamination

Recommendation 6: Development of improved water and nutrient management to improve water-use efficiency and water quality.

Recommendation 7: Overcoming factors limiting crop production when growing corn, horticultural and flue-cured tobacco crops with reduced tillage.

Recommendation 8: Determine the NPK fertility impacts on functional food, nutraceutical and other quality aspects of horticultural and field crops, to provide a basis for management of value-added crop production with increased profitability and reduced environmental impact.

Recommendation 9: Quantify the emission of greenhouse gases and the potential for C sequestration from agricultural activities, particularly in relation to soil, crop residue and organic amendment management.

Recommendation 10: Determining key soil quality characteristics for the development of improved soil management systems

Recommendation 11: Improving secondary and micronutrient fertilization of field and horticultural crops

Recommendation 12: Study the fertility requirements of flue-cured tobacco production under the higher plant populations used in automated harvesting technologies

Recommendation 13: Management of organic matter amendments on horticulture crops and flue-cured tobacco production systems

Recommendation 14: To investigate the effectiveness of urease inhibitors and fertilizer enhancers as a means of increasing fertilizer use efficiency and crop productivity

Recommendation 15: Development and calibration of multi-element extractants suitable for Ontario soils.

Motion: That OSWARSC express concern to the federal NR group regarding the inadequate level of representation of agricultural interests in the development of the assessment of Nutrient Impacts on the Environment and the ensuing action plan. (Bruuelsma, Ryzebol) Vote 7-1. Carried

Provincial Soil:
Craig Drury and Ian Jarvis have been pursuing this through discussions with Richard Protz. There has been correspondence with soil scientists from other jurisdictions like Jim Robertson and Wally Fraser to determine the approach taken elsewhere.

Developing criteria for the Ontario soil-
- covers a large are or has wide distribution
- photogenic
- economic value in terms of agriculture and forestry
- proximity to urban centres
- unique to Ontario
- historical importance

Craig and Ian to continue to pursue and to develop a list of potential candidates

Next meeting June 11-12, 2002, Harrow

Ontario Water Management Research & Services Committee
Annual Meeting: Sept. 25, 2001.

Present:
Paul Sibley: Environmental Biology, University of Guelph.
Chin Tan, Agriculture and Agri-Food Canada
Dan Reynolds, Agriculture and Agri-Food Canada
Ramesh Rudra, Engineering, University of Guelph.
Keith Reid, OMAFRA
Debbie Brander, Dairy Farmers of Ontario
Betty Semeniuk, Ontario Federation of Agriculture
Gary Parkin, Land Resource Science, University of Guelph.

Regrets:
Elbert van Donkersgoed, Christian Farmers Federation
*Mike McMorris, Ontario Cattlemen's Assoc.
*Sam Bradshaw , Ontario Pork
Michael Goss, University of Guelph\OMAFRA.

* not present at meeting but submitted research suggestions.

Meeting Agenda:
1.Introductions, 2. Review of 2000 Report, 3. Current Issues\Outline of Report
4. Workshop and New Business

Current Water Management Issues and Recommendations

The emerging water management research and service issues are given below. **Research Issues** are presented first with recommendations given in point form after each issue. Research issues can be divided into those related to water quality (Issues #1 and 2) and those related to water quantity (issues #3 and 4). Note that the two divisions are equally important and are interrelated.
These research issues and recommendations are very similar to those presented to OSWARSC last year.

1. Manure Management:

- identification of transport pathways of bacteria and other pathogens to groundwater.
-investigate alternatives to liquid manure such as use of organic bedding material and composting.
- pilot-scale testing of new methods of managing\utilizing liquid manure such as composting, condensing, pre-treatments, energy from manure (eg. methane digestion).
- testing of BMPs for liquid manure application timing and methods.
-evaluate the effectiveness of new controlled rate application technologies (flow meters with injection booms) vs. current methods.
- scale of farming operation versus amount of leaching and runoff losses of pathogens and nutrients.
- leaching losses of feed supplements such as growth hormones, antibiotics, micro-nutrients.
-benchmark standards for tile water quality.

2. Management of Non-Manure Fertilizers and Pesticides

- identification of transport pathways of NPK fertilizers and pesticides.
- validation and testing of BMPs for nutrient and pesticide management.

3. Water Source, Transport, and Sharing

-establish a sustainable water extraction policy and monitoring system.
- should surface water or groundwater be main sources of potable water?
- urban\rural groundwater sharing, well head protection strategies.
-irrigation management for water conservation and reduction of leaching losses of fertilizer and pesticide.
-rural development strategies to limit the number of new water wells and promote the use of innovative septic systems.

4. Farm Water Cycle

-determine the potential impacts of climate change on water surplus and deficits in the future for different regions in Ontario.
- quantify water pathways including runoff, tile drainage, and deep drainage.
- design of buffer strips, vegetative filter strips, and wetlands to enhance protection of surface and ground waters including a cost\benefit analysis.

Scaling is an issue that was put forth as being fundamentally important to all four of the issues given above. For example, there is a need to understand how to properly scale-up parameters measured at a small scale for use in watershed (or even larger scale) models of water and contaminant transport.

The following were classed as **Service Issues** by the committee.

5. Database for water management.

- design and maintain a web-based database for hydrological information and data required to run computer models of water flow and contaminant transport in Ontario.

6. Database for current and past groundwater and surface water quality and quantity.

- design and maintain a web-based database that would have information on current and past groundwater and surface water quality and quantity in Ontario.
-baseline monitoring of groundwater and surface water quality and quantity in Ontario with data available on the web site described above.

The two service issues (Issues 5 and 6) may be partially addressed by the Water Resources Information Program (WRIP). The WRIP is a strategic review of water information programs being compiled by the provincial cluster ministries and Conservation Ontario.

Appendix II – Committee Membership

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Field Crops, Soil and Environmental Quality Team
Southern Crop Protection and Food Research Centre

Research Facilities in London, Delhi, Vineland

Team Members

Dr. Bonnie Ball-Coelho	Soils and crop production
Dr. Ron Beyaert	Soil quality
Dr. Bruce Broadbent	Entomology, biocontrol
Dr. Ralph Chapman	Chemistry
Dr. George Lazarovits	Plant pathology
Dr. Brian McGarvey	Chemistry
Dr. John Potter	Nematology
Dr. Rick Reeleder	Plant pathology
Mr. Bob Roy	Agronomy
Dr. Jeff Tolman	Entomology
Dr. Ed Topp (Team leader)	Soil microbiology
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Research of the Field Crop, Soil and Environmental Quality Team at SCPFRC emphasizes contaminant fate, soil quality, and the development of farming systems which minimize environmental risk. The overall goal is to improve soil and environmental quality in the Great Lakes Basin by developing superior management practices that preserve and enhance land resources while maintaining economic benefits to society and minimizing risk to adjacent environments. Team members, subgoals, activities and publications can be viewed on our web site at http://res2.agr.ca/london/pmrc/english/pmrchome.html

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Soil Quality

1. Cropping and tillage systems to enhance soil carbon sequestration. R. Beyaert, R. Reeleder (SCPFRC); R.P. Voroney (U. of Guelph)

Greenhouse gas emissions and climate change are important issues to agriculture both because of their potential impacts on agricultural production and because agriculture is a contributor to the build-up of greenhouse gases in the atmosphere. Soil organic carbon levels are determined by the balance of inputs, such as crop residues and organic amendments, and carbon losses through organic matter losses. Thus, management of agricultural soils to sequester carbon required increasing inputs, decreasing decomposition or both. To investigate the effects of cropping and tillage practices, plots were established in 1989-1990 with three cropping systems, Continuous Corn, Soybean-Wheat and Tobacco-Rye systems each managed under conventional and no-tillage. Sampling following the 12th year of management and 10th year of decomposition study will be completed during the 2000/2001 fiscal year.

2. Impact of vegetable production practices on soil processes. J. Tolman

Two long-term experiments evaluating effects of vegetable production practice on soil process continued in "maintenance mode" in 2001. Production practices have been maintained but the amount of field sampling has been greatly reduced. The number of vegetables grown each year has been reduced from 5 to 1. Planned long term, maintenance rotation will be sweet corn/clover/snap beans in ORGANIC plots and sweet corn/summerfallow/snap beans in CONVENTIONAL plots. Sweet corn was grown in 2001. Yield was greatly reduced due to severe drought at the critical silking stage of development. After 11 years, soil organic matter is 40.1% higher in ORGANIC plots than in companion CONVENTIONAL plots (4.4% vs. 3.1%).

3. Method development for evaluating impacts of GMOs on soil biology. E. Topp, R. Beyaert, G. Lazarovits, B. McGarvey, R. Reeleder, J. Tolman, J. Traquair (SCPFRC); C. Fox (GPCRC).

It is highly likely that plants which have traits introduced using biotechnology are going to dominate crop production in the future. Input traits which protect crops against pathogens and reduce pesticide use have the potential to improve crop quality and reduce environmental pollution by pesticides. Output traits consisting of vaccines, antibodies, and other proteins will add tremendous value to crops. The major barrier to implementation of this technology has been public concern about the possible risks of these crops to environmental and human health. Furthermore, regulators are now faced with assessing the real risk of transgenic crops to the environment using the best available science. Part of this risk assessment concerns the possible deleterious effects of GMO crops on agricultural soils, and the fate of transgene products in soils. There is a real need to conduct research on developing methods to assess the risks of transgene crops. The primary focus of this study is the assessment of transgene crop impact on agricultural soil biology (bacteria, fungi, mites, springtails, earthworms, surface-active beetles) and functions (carbon and nitrogen dynamics), and the persistence of transgene protein products in soils.

4. Control of soilborne pests by application of livestock wastes and other organic amendments. G. Lazarovits (SCPFRC); Ontario Potato Marketing Board, Rothsay Inc., Ontario Pork, Canadian Adaptation Council, Nuhn Industries, Fats and Proteins Foundation (USA).

Potato growers have been reluctant to use manures because of the fear of increasing the incidence of soilborne plant diseases. The objective of this project is to determine the impact of manures on such diseases of potato (*Verticillium* wilt caused by *V. dahliae*, potato scab caused by *Streptomyces* spp., and root lesions caused by nematodes). We have shown that manures can significantly reduce populations of these pathogens in soils under certain conditions. The potential efficacy was dependent on the source of the manure, the soil type, and the moisture content of the soil. Some laboratory results have shown that certain manure-soil mixtures can increase populations of *Streptomyces* which may translate to higher disease incidence. We are investigating this further. A rapid laboratory assay was developed that accurately predicts how a manure will affect populations of these pathogens in a particular soil. The accuracy of this test was confirmed by carrying out parallel laboratory and field experiments. This should provide technology whereby growers can pretest specific manures prior to application to determine the impact on plant pathogens. The disease protection has been extended over a two year period and that with some manures, particularly poultry, there was a significant yield increase in the second year, but not in the first, likely because of some residual phytotoxicity.

5. Mitigation of contaminant transfer to the environment from fertilizer and manure by cover cropping, soil testing and appropriate rates and methods of application.
B. R. Ball Coelho, R. C. Roy (SCPFRC); Nuhn Industries, Green Lea Ag Centre, Da Costa Farms, Kevin Otto, Ontario Pork, Chris Brown (OMAFRA), A & L Laboratories

Transfer of nutrients to ground and surface waters following manure application can be minimized and crop nutrient utilization maximized by appropriate methods, timing and rates of application. Optimum timing for manure application to corn may be sidedressing because soil moisture content is usually lower and application rates can be determined more accurately than for fall or spring applications. In order to improve the prediction of manure sidedress rates based on the pre-sidedress nitrate test (PSNT), corn yield response curves to sidedress liquid manure injection in relation to the PSNT, transfer of contaminants to drainage waters, and residual soil N are determined. Where liquid hog manure dry matter is high (>4%), sidedressing manure (with modified injection equipment) at rates which supply crop N requirements, does not contaminate tile drainage water.

Numbers of intensive livestock units are increasing in sandy soils, where management practices to minimize environmental contamination following manure application differ from best management practices for tile-drained systems. Conservation tillage systems are most appropriate for coarse-textured soils, but many livestock producers have rejected or abandoned no-till due to difficulties associated with manure injection. Injection solves application-related odour problems, maximizes nutrient-use efficiency and reduces movement of contaminants to surface waters. Optimal injection units vary with soil texture and cropping system. Nutrient movement

to groundwater is monitored following pre-plant injection for no-till corn in sandy soil. In systems where N is supplied by inorganic fertilizer, residual N not taken up by a corn crop can be recycled and nitrate movement to groundwater reduced by overseeding cereal rye into standing corn. Capacity of the overseeding system to control nitrate leaching in manured systems is under investigation. Preliminary results indicate that nitrate leaching is similarly reduced by the cover crop in systems where N is supplied by liquid hog manure.

Water Quality

6. Environmental persistence and impacts of endocrine-disrupting chemicals and antibiotics. E. Topp, B. McGarvey (SCPFRC); M. Servos (Environment Canada); T. Ternes (ESWE, Germany); S. McEwen (U. of Guelph); Toxic Substances Research Initiative.

Agriculture is accused of being a source of chemicals which interfere with the reproduction and development of wildlife. These so-called endocrine disrupting chemicals cause fish to produce offspring which are part male and part female, for example. Chemicals of concern include some pesticides and components of pesticide formulations, natural estrogenic hormones in some animal wastes, and synthetic organic compounds which can be carried by municipal biosolids applied to land. The persistence and breakdown of various natural (estradiol, estrone) and synthetic (ethynylestradiol, 4-nonylphenol) EDCs is being evaluated in field and laboratory studies. Laboratory microcosm studies indicate that all of these compounds are rapidly microbially degraded without production of estrogenic intermediates.

There have been recent concerns about the environmental impact of veterinary antibiotics, or antibiotic-resistant bacteria excreted by animals. We are conducting laboratory experiments examining the impacts of antibiotics on soil processes, and on the abundance of antibiotic-resistant bacteria. We are also evaluating soils fertilized with manure from medicated and non-medicated animals for differences in the abundance of antibiotic-resistant bacteria. Transport of antibiotics through intact lysimeters is being evaluated by German cooperators.

7. Stimulation of pesticide-degrading microorganisms in soil. E. Topp (SCPFRC); A. Hartmann (INRA); W. Mulbry (USDA).

The persistence of pesticides in soil is largely determined by microorganisms that have the ability to degrade these chemicals. Ideally, soil-applied pesticides persist the minimum time required to ensure efficacy but minimize the chance of off-site movement. Bacteria that degrade atrazine were found to increase with the frequency of soil application of this commercially important herbicide used in corn production. Manuring soil also increased their abundance. Isolated bacteria are being characterized with respect to the genetics and biochemistry of herbicide biodegradation. This information is being used to explore and predict how bacteria adapt to the introduction of xenobiotics into soil, how their activity may be stimulated through the addition of organic amendments, and bacterial traits that determine competence for bioremediation.

8. Enhancement of water use efficiency for crop production. B. Ball Coelho, R. C. Roy, R. Beyaert (SCPFRC); Ontario Processing Vegetable Growers, Robin Hood Multifoods Inc. End:March 2002

Surface and subsurface drip irrigation can increase water use efficiency by minimizing losses to evaporation, improving scheduling and increasing the capacity for control of internal drainage. Subsurface fertigation further provides opportunities to utilize nutrients more efficiently and improve water quality through better timing of application and placement of nutrients, and minimal water losses by deep percolation and erosion. Many advances in subsurface drip irrigation have been made in recent years, however, most of the work has been done in loam soils and little is known about how these systems behave under Ontario climatic conditions and coarse-textured soils. To develop advanced irrigation methods that improve water-use efficiency and minimize nitrate leaching, experiments were conducted to compare water use efficiencies and nitrate leaching of overhead, surface drip and sub-surface drip irrigation, and traditional dry broadcast fertilization with fertigation.

9. Ecology of *Escherichia coli* and other microbial components of livestock waste in soils and stored manures. E. Topp, G. Lazarovits, B. Ball Coelho (SCPFRC); Ontario Pork, Nuhn Industries.

Enterohemorrhagic *Escherichia coli* is the most important recently emerged group of food-borne pathogens. Human and livestock exposure to fecal pathogens via contaminated surface or groundwater is an important health concern. There have been frequent recent high profile closings of beaches due to coliform contamination, suspected but not proven to originate from livestock operations. Survival of fecal bacteria in soil and on crop surfaces is an important element of the environmental and health risks of manure application. The focus of this study will be to characterize the microbial composition and survival of enteric bacteria and pathogenicity genes, and antibiotic-resistant bacteria in manure under different storage conditions, and in soil following broadcast or injection application. Ten commercial manure odour control agents were tested for the ability to suppress *E. coli* in swine manure slurry; none of them were found effective at reasonable concentration.

Biosolids Research Priorities
Presented to OSWARSC
November 22 / 23, 2001

1 Investigation of pathogenic microorganisms in sewage biosolids and other land applied wastes, including: fate and persistence; risk of movement to surface and groundwater; risk of adverse affects on plant, animal and human health; and best management practices necessary to reduce identified risks.

- Investigate the fate / survival rate when land applied under various scenarios (surface application with & without incorporation, injection, etc.)
- Investigate the potential for movement through soil matrix to either ground water or tile lines and practical management practices to reduce risk.
- Investigate the potential for off site surface movement and practices to reduce risk.
- Identify if E.Coli and Fecal Coliform are the appropriate indicators for what organisms are potentially in land applied sewage biosolids.

Background / Justification
Sewage biosolids, manure and other land-applied wastes contain pathogenic microorganisms. Currently treatment before land application is required to reduce pathogen content and stabilize the material prior to land application. Indicator organisms such as E. coli & Fecal Coliforms are used as measures of pathogen occurrence and reduction. Studies have shown that with established treatment procedures, microorganism numbers are reduced but not eliminated. Therefore, as a safety measure, waiting periods before crop harvest or grazing have been set out in the *Guidelines for the Utilization of Sewage Biosolids and Other Residuals on Agricultural Land, March 1996* for fields that have received a sewage biosolids or other waste that may contain pathogenic microorganisms.

There have been questions raised regarding the types of pathogens present in land applied sewage biosolids, their numbers, their fate when applied to crop land and ultimately the potential for movement of these organisms into either surface or ground water.

Much of the information on pathogens applied to soils has been developed by the World Health Organization (WHO), for the most part for wastewater irrigation. Some data on pathogen survival times following biosolids application are shown below in Table 1:

Table 1: Pathogen Survival Times (WHO, 1980)

Pathogen Class	Survival Times (mths)			
	In Soil (injected or incorporated)		On Crop (on surface)	
	Typical	Maximum	Typical	Maximum
Bacteria	2	> 12	1	6
Helminth Ova	24	84	1	5
Protozoa	2d	10d	2d	5d
Viruses	3	6	1	2

Research on survival under Ontario conditions is needed to establish appropriate safety factors to prevent health risks. Survival times depend on several factors, including temperature, sunlight, solar radiation, type of pathogen , and soil characteristics such as: moisture (desiccation), pH, organic matter content, nutrient content and the natural soil microflora present .

Also, survival times for pathogens may be different in biosolids applied on the soil surface, rather than below the soil surface. This research may provide BMPs for pathogen risk management that are opposite the BMPs for odour control, vector attraction reduction and minimizing public contact.

The research will provide data to support the review of existing waiting periods, cropping restrictions, timing of application, application techniques and setback distances. The research may also identify additional best management practices to minimize potential health risks, such as requiring pre-tillage of tile-drained sites prior to biosolids application.

This study would complement current WERF research studies by the University of California and the University of New Hampshire currently in progress. The study could also be co-ordinated with a study proposal put forward by the Northeastern Regional Association of Agricultural Experimental Station Directors (NERA). This group in the Northeast US have put forward a study proposal to "Assess pathogen survival & transport". The second study proposal regarding types, fate & movement of pathogens from the Water Environment Association of Ontario (WEAO) is currently being worked on.

2 ***Investigation of the potential for off-site aerosol transport of chemical and biological contaminants in sewage biosolids and other organic-based wastes, and the risks that such transport pose to plant, animal and human health.***

* Measurement of both the chemical & biological contaminants that are susceptible to uptake by wind and subsequent movement off-site in aerosols .
* A determination of the potential for off site movement
* The impacts of the generation and possible movement of potentially harmful aerosols.
* The development of BMP's to reduce the occurrence of potentially harmful aerosols.

Background / Justification
Bioaerosols are typically associated with aspergillus fumigatus, a fungi that grows naturally in open composting operations, but are not present in appreciable densities in biosolids. Endotoxins produced by aspergillus can result in health risks to individuals with suppressed immune systems. Transmission of other types of pathogens by bioaerosols have not been well researched.
Data from the study could support the development of BMPs, such as the type of application equipment and maximum wind speeds during spreading of dewatered biosolids

3 ***Investigation of the potential risks that unregulated metals and other elements in sewage biosolids or other wastes may pose to the environment or plant, animal and human health.***

* Thallium, beryllium, & silver are of particular interest.
* Survey to determine the concentrations in municipal sewage biosolids.
* Determine the fate and potential transport within the food chain.
* Investigate the potential risk to human health from land applied sewage biosolids & other wastes containing these elements.

Background / Justification
Questions have been raised regarding the concentrations & fates of some inorganic contaminants that may be present in sewage biosolids or other wastes. Of particular interest are beryllium, silver, and thallium in the heavy metal group. There is some evidence that very small quantities of these elements may pose a risk to human health through uptake and accumulation in the food chain.

At present there is limited data on the concentrations of these contaminants in Ontario sewage biosolids and even less information as to the fate of them once land applied. Currently the Ontario Ministries of Environment & Agriculture, Food and Rural Affairs in co-operation with the University of Guelph, various municipalities and the farm community are conducting a survey of sewage biosolids and agricultural soils in the Province.

4 ***Investigation of the potential risks that organic compounds or their residuals in sewage biosolids or other wastes pose to the environment or plant, animal and human health.***

* An in depth study of the types of organic contaminants potentially in biosolids & other wastes destined for land application and their potential risk to the environment and animal & human health.
* The fate of those contaminants in the treatment process, storage and after land application.
* A determination of the residuals from the decomposition of the organic contaminants and their potential risk to the environment and animal & human health.

Background / Justification

The public has questioned all aspects of sewage biosolids land application and has specifically questioned the lack of measurements of organic compounds. To date there have been a limited number of studies to determine the types and concentrations of organic compounds in sewage biosolids and even fewer studies that have looked at the fate of these contaminants after land application.

A study is needed that looks at the concentrations of these compounds in sewage biosolids and their fate in the soil.

Prepared by: Michael Payne CCA
OMAFRA Biosolids Utilization Specialist

Precision Agriculture Champion 2001 Update

Doug Aspinall
OMAFRA

What is happening in Ontario?

Private

- Satellite imagery can be purchased ($1.50/ac) and processed for the purposes of delineating management zones. Imagery is provided by AgriFood Labs. Customers include individual producers as well as other service providers. 200,000 to 300,000 acres per year?
- Preference is to use bare soil imagery
- Customers demand grid sampling and smart sampling services
- Producers are also willing to pay for gps field boundaries for acreage calculations
- The application of lime appears to be the number one choice of precision application. There are many testimonials of how cost beneficial this practice has been. Much attention is being paid to sandy knolls.
- It appears that increasing numbers of producers are applying variable rate side dress nitrogen. There is a considerable range in technology being used, all the way from on off switches to on board computers, flow meters and application maps. Raven controllers are quite popular, PF 3000 can be easily modified to control flows for about $1000. Applicators may be using visual clues while driving such as landscape position (ie. Knoll/depression) and soil colour to change the N rate or sophisticated application maps derived from elevation, EMI, yield, topography and soil nitrate sampling.
- General consensus seems to be that nitrogen rates can be decreased in the depressional areas and full rates applied to the knolls. Some growers are interested in variable rate but are still unsure of where to make the changes with confidence.

Concern: research has provided some support to this notion, however there is also some evidence to suggest that lower uniform rates are more appropriate than variable applications. Previous crops and manure/biosolid application must be accounted for. Still unsure of the seasonal effects on the response to nitrogen fertilizer.

- Producers are turning off yield monitors or not purchasing when upgrading the combine-expense of gps upgrades/equipment, not seeing a reasonable return from the monitor, the expense of computer and software upgrades, data management, processing, interpretation difficulties, time consuming, steep learning curves
- However other producers are experimenting with recording seed drop, others have had success with variable populations where lower populations are applied to sandy knolls, others are looking at variety response
- Many producers turned the yield monitors off this fall, especially while harvesting soybeans. It is unfortunate since it is the yield pattern, not the absolute yield which is important
- Some producers may have as much as 10 years of yield data. I'm not sure what they are doing with it. I have heard of "old" data being erased.

Appendix III – Issue Champion and Other Reports

- Agrifood labs in conjunction with Cargill have variable rate nitrogen trials throughout the province on customer fields. Jim Shaw reported on some results at the InfoAg Conference.
- Several dozen light bars for guidance are being used in Ontario
- A few drainage contractors have acquired and installed on the plows high resolution GPS systems for purposes of design and tile installation
- Hall Tech now has a GPS system that will provide cm accuracy for x,y and z at a cost of $7000.00
- GPS is now being used to track manure application by load
- Manure tanker technology now includes variable rate application using flow meters and gps
- Overall sense of what is happening with precision ag. in Ontario- in some quarters I think it is looked upon as still being exciting and challenging and will ultimately be very useful, in others it is viewed as frustrating and disappointment or disillusionment

Government and University:

- 2001- nitrogen rates and variable rate strips installed on 20 fields
- preside dress nitrate samples taken from the alternative N rate strips by landscape position, up to 200 per field
- variable rate applications of 2 kinds:
  - MERNs were calculated from previous N response data
  - 2 rate variable application, usually 1X and .75X where on the first pass the 1X is applied to the depressions and the .75X to knolls and on the return pass the opposite is applied, a uniform 1X and .75X pass is included as well
- grain corn quality study, 2nd year, samples taken from different landscape positions in each of the N rate strips, will examine starch, protein, oil
- 30 cm resolution aerial photography of most of this year's fields, red, blue, green and near infrared, 4 to 5 times during the growing season
- 8 of our sites have been included as part of the nitrogen benchmark study

United States:

What's going on?

- In a nutshell – lots,
- are they any further ahead? Don't think so, in spite of all advancements in technology
- major crops occupy about 250 million acres, there are about 25,000 intelligent combines, 45-50 million acres are harvested with a yield monitor, 25-30 million acres are managed spatially and about 15 million acres have variable rate inputs
- expectations of precision ag and reality are not in sync as it is here in Ontario
- societal concerns such as traceable quality of produce/food, consistent quality of produce/food, taste, nutritional value, conservation of resources and the

environmental impact of agriculture may drive precision ag to provide the answers, Identity preserved – two words I heard a lot, often in association with precision ag.

- 2 problems in precision ag are low quality data, data rich and information poor, 2 tools coming on line are new real time sensing technologies and data to knowledge (D2K) conversion tools
- corn population sensors- mechanical and optical, looks promising
- lots of talk about management zones and just as many ways to delineate, still not using yield data to the extent we are, lots of reliance on soil maps (suitable scale in the US). 1 speaker equated management zone to soil type
- internet in the cab, used for diagnostics
- all kinds of software, usually all expensive
- speech based systems for crop scouting
- visit www.ppi~far.org/infoag for all papers presented at the InfoAg 2001 conference
- precision irrigation in Georgia
- auto steer trackers form Trimble Navigation Ltd.
- Still a lot of effort placed into grid sampling

Appendix IV– Glossary of Acronyms

Agencies / Associations / Centres / Departments

AAFC	Agriculture and Agri-Food Canada
ARIO	Agriculture Research Institute of Ontario
CARC	Canadian Agri-Food Research Council
EC	Environment Canada
ECORC	Eastern Cereal and Oilseed Research Centre, AAFC Ottawa
GPCRC	Greenhouse and Processing Crops Research Centre, AAFC Harrow
KCAT	Kemptville College, University of Guelph
LRS	Land Resource Science Dept., University of Guelph
MOH	[Ontario] Ministry of Health
NWRI	National Water Research Inst., Environment Canada
OCPA	Ontario Corn Producers Association
OCSRE	Ontario Centre for Soil Resource Evaluation
OIP	Ontario Institute of Pedology
OLRU	Ontario Land Resource Unit, Agriculture and Agri-Food Canada (closed 1998)
OMAFRA	Ontario Ministry of Agriculture, Food and rural Affairs
OME	Ontario Ministry of the Environment (see also OMEE)
OMEE	Ontario Ministry of the Environment and Energy (see also OME)
OMNR	Ontario Ministry of Natural Resources
OSCIA	Ontario Soil and Crop Improvement Association
PFRA	Prairie Farm Rehabilitation Administration
SCPFRC	Southern Crop Protection and Food Research Centre, AAFC London
U of G	University of Guelph

Appendix IV– Glossary of Acronyms

USDA	United States Department of Agriculture
US EPA	United States Environmental Protection Agency

Committees

ARSC	Animal Research & Services Committee
BUC	Biosolids Utilization Committee
OASCC	Ontario Agricultural Services Coordinating Committee
OARSC	Ontario Agrometerology Research and Services Committee
OERSC	Ontario Economics Research and Services Committee
OFCRSC	Ontario Field Crop Research and Services Committee
OFPRSC	Ontario Food Processing Research and Services Committee
OSMRSC	Ontario Soil Management Research and Services Committee
OSWARSC	Ontario Soil, Water and Air Research and Services Committee
ORCDRSC	Ontario Rural Community Development Research & Services Committee
OWMRSC	Ontario Water Management Research and Services Committee

Programs

CURB	Clean Up Rural Beaches [Program] - OMEE
GLWQP	Great Lakes Water Quality Research Program (Agriculture Canada)
HEMS	Hog Environmental Management Strategy (AAFC)
NSCP	National Soil Conservation Program (Agriculture Canada)
NSWCP	National Soil and Water Conservation Program
OREP	Ontario Research Enhancement Program
PINUE	Partnerships in Nitrogen Use Efficiency (Water Quality Working Group)

Appendix IV– Glossary of Acronyms

SWEEP	Soil Water Environment Enhancement Program

Terms

BMP	Best Management Practice
DSS	Decision Support System
EDC	Endocrine disrupting compound
EFP	Environmental Farm Plan
GHG	Greenhouse gas
GIS	Geographic Information System
GPS	Global Positioning Units
IROWC - N, -P	Indicator of Risk of Water Contamination - for N, - for P
McCLONE3 NMAN98	Computer Manure/Nutrient Management Programs
NMP	Nutrient Management Plan
NPS	non-point source
SSCM	Site-Specific Crop Management

Appendix V– Provisional Committee Meeting Dates 2002

Provisional Committee Meeting Dates - 2002

Committee	Location	Dates
OASCC	OMAFRA, Guelph	February 27
OSWARSC	OMAFRA, Guelph	November 5-6
OARSC	TBA	Fall
OSMRSC	Harrow	June 11-12
Field Crops	OMAFRA, Guelph	February 27
Horticultural Crops	Woodstock	March 22
Soil and Water Quality	OMAFRA, Guelph	February 22
Soil Test Lab	TBA	June 5
Waste Utilization	TBA	March 7
Tobacco	Delhi	April 25
OWMRSC	Guelph	Fall